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FACTORY

MANAGEMENT AND MAINTENANCE

APRIL 1948

IN TWO PARTS—PART TWO

INDUSTRIAL PLANT BUILDINGS

Fourteenth Annual Presentation

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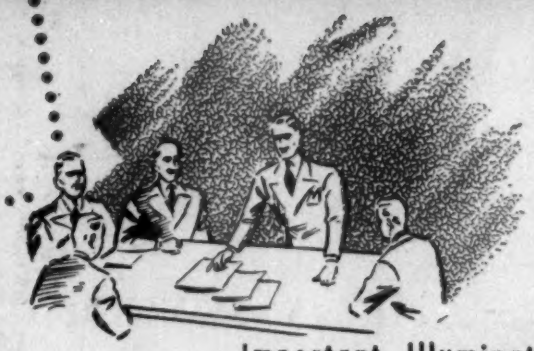

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AUTOMOTIVE DECENTRALIZATION. Assembly plant for Buick-Olds-Pontiac Division of General Motors Corporation, near Wilmington. Size 800x1300 feet; second floor one-third area of first. Structural steel frame; metal floor construction; brick and glass walls. V-shaped administration building for good natural lighting. Plenty of room for expansion as needed

NEW PLANT BUILDINGS FOR LOWER PRODUCTION COSTS

● A properly designed plant is one of industry's most effective tools in cutting production costs.

Of the need to reduce these costs there can be no question. It is essential.

In the matter of how to do it, many ways are open. Prominent among them are layouts that produce more efficient operation; better facilities for handling and storing raw materials and finished products; better lighting; provisions for worker health and comfort that keep morale high and are in keeping with today's needs and trends.

These and other aids to greater output at lower unit cost are inherent in a properly designed plant.

With many industrial concerns the need for new facilities cannot be questioned. Their present plants are outmoded and outgrown. They cannot produce enough goods to satisfy the demand and make sound growth possible. The buildings do not allow the most effective layouts and handling; in consequence, costs are high and it is difficult to do much about them. Another serious handicap may be an unfavorable location from the standpoints of company markets, raw materials, labor supply, and transportation.

To other companies the need for a new plant may be less obvious or urgent. Then the decision to build or not to build may be much more difficult to make. An important deterrent is the fact that today it costs somewhere between one and one-half and two times as much to put up a new plant as it did in 1939.

The chances of any immediate relief from the present high building costs seem remote. However, there are cost-reducing factors at work. There will likely be recessions in the prices of some industrial building materials as manufacturing economies come into play and supply more nearly balances demand. The ingenuity of experienced architects will develop more new ways to shave construction costs. Performance of building-trades workers, too, may improve and thus help to bring costs down. When and by how much these possibilities

will influence building costs significantly remains to be seen.

Painstaking analysis of the economies and other advantages offered by a new plant must therefore be balanced against the cost, in deciding what to do. And, of course, the possibility of making changes that will better fit the old plant to meet new conditions will be considered with care.

One of the early steps in such a study should be a critical examination of the present location, from the standpoint of its suitability from every angle. There are many factors that may dictate the advisability of moving to another town, to another section of the country, even into a rural area.

The advantages of decentralizing operations is another matter that is worthy of thought. Manufacturing units may become so big that they tend to be unwieldy. Decentralization means smaller units that foster higher efficiency, easier control, better transportation and housing facilities for workers, perhaps even greater opportunity for expansion.

It must not be overlooked that some important advantages of a new plant are not so readily translated into dollars-and-cents savings as are good layouts and handling methods. Intangible, they are none the less real and valuable.

Among them are more healthful and comfortable working conditions with respect to heating, ventilation, eating and sanitary facilities, opportunities for recreation, and a convenient place to park. Also, a plant that is good to look at is an asset to a neighborhood. Anything that makes for better industrial and public relations is almost certain to be an important factor in the reduction of costs.

Lower cost of manufacture as an objective is always present. The process of lowering costs and then prices of industry's products must be continuous. It is only by continually increasing the output gained from a given input in our manufacturing operations that we are able to distribute goods and services more broadly, and raise the standard of living. Our whole economy is bound up with this procedure.

As we participate in the economic affairs of other countries, our efforts toward cost reduction take on international aspects. Obviously the cost of the housing in which we carry on our manufacturing operations takes on added importance as the difficulties of reducing costs increase. They do increase in a period of inflation. They do increase as we take on new obligations abroad.

In the following pages FACTORY shows how industry is solving some of its important housing problems, both with new plants and with good maintenance of the old.

BUILT AROUND MECHANIZED HANDLING of drug products, warehouse for McKesson & Robbins, Inc., at Houston, is also designed to fit Texas climate. Forced ventilation in warehouse areas. Air conditioning in offices; ceiling-high windows of heat-resisting glass, with wide exterior overhang to keep out direct rays of sun and insure shadowless, glareless illumination

TRENDS IN PLANT DESIGN AND CONSTRUCTION

● Certain developments in industrial building construction over the past few years may now be cited as significant trends:

1. Building the structure to fit the process layout is strongly favored.

2. Structural design is more carefully arrived at. Engineers tend to weigh strength and durability of various types of construction against their relative cost to obtain maximum performance from the structure at minimum cost.

3. Wider column spacing is being demanded by owners. They want structures providing maximum flexibility.

4. Factors affecting personnel and public relations get more attention in the building budget. Plants are being designed to enhance and beautify the communities in which they are located.

5. Hoped-for post-war wonders in new materials have simmered down considerably.

6. Windowless construction has not found widespread favor, except where closely controlled conditions, such as temperature, lighting, and humidity, are essential.

7. Provisions for expansion are being incorporated in many plants.

8. Underground plants are not likely to be built soon. Cost is too high, and wartime safety is at present questionable.

Nationally recognized engineering and architectural firms are in general agreement on the following trend indicators:

1. Structural design. Probably the most marked trend in structural design is the increased development of rigid or semi-rigid frames in steel as well as concrete. Economy through reduced sizes of members and simplification of bracing results. Increased use of welding is leading to economies in steel construction, although welded structures are not as yet approved by all municipal building departments. Higher permissible concrete stresses are enabling use of smaller members. Pre-cast concrete members, offering advantages in speed and in-place costs, are beginning to come into general use. In timber construction, stress grading of materials and developments in laminated members are promoting reliablity in strength.

2. Column spacing. The average plant built before the war probably had 150 interior columns for every 100,000 square feet of floor space. The great majority of plants today have reduced the average to 40 by using bays 40x80, 60x60, and, in some instances, 25x100 feet. While the cost of increased spacing is higher, it does not appear to be exorbitant when reduced to a percentage of total building cost.

3. Production layout. There is increasing cooperation between owners and engineers in studying layout problems, according to The H. K. Ferguson Company, Cleveland. Before deciding which type of building and what materials to use, a clear picture should be had of the process-housing problems.

4. Walls and windows. Leaders in the building materials industry have developed a practical insulated metal panel which is causing changes in wall construction. These steel and aluminum panels, with rigid insulation between sheets of metal, furnish one answer to future plant expansion. First cost is reasonable.

Cinder block covered with cement stucco or portland cement paint makes an economical outside wall.

For interior walls, there has been a growing use of glazed tile of various grades in plants where housekeeping is a subject of primary concern. Concrete blocks and acoustic blocks of various sorts have been used extensively in many structures.

5. Windows. Large areas of glass are to be found in the newer plants. Continuous sash of aluminum and steel are used in permanent and temporary walls, as well as in monitor and sawtooth roofs. Extensive use of large window sections appears to be made for cost and psychological reasons. In several installations of solid glass-block walls, window-glass inserts have been provided to allow employees to see out. The newer twin-wall sash have insulating value and are being used in increasing amounts.

6. Lighting. Wide difference of opinion exists among engineers on the fate of monitor and sawtooth construction. Some claim light from sidewall sash and fluorescent fixtures is sufficient and makes possible flat roof structures with long spans. Others hold that monitors and sawtooth roofs are here to stay for lighting and ventilation purposes in certain industries.

Fluorescent lighting is definitely in vogue. Design intensities, say A. Epstein & Sons, Chicago, continue upward, with 50 to 100 foot-candles becoming quite commonplace in finished spaces.

There is also a tendency, report Caproni Associates, New Haven, to eliminate skylights and to use only artificial lighting in the interiors of buildings.

7. Roofs. Cooling of roofs, by means of sprays and by water retained on the roof, is a practice becoming more common, according to Rust Engineering Company, Pittsburgh. These methods are particularly suited to southern industrial buildings. The Rust Company adds that this is an eminently practical and economical approach to the

Photograph by courtesy of The Austin Company

TREND TOWARD CONTROLLED CONDITIONS when required by process is exemplified by new plant for Bayer Company Division, Sterling Drug, Inc., Trenton. Temperature, humidity, and lighting are closely regulated. Pre-cast concrete tile roof. Glazed tile and glass block walls in conditioned area. Explosion-proof electrical distribution system

problem of keeping interiors cool in hot climates.

One company has resorted to the cantilever girder-type of roof construction. Walter Kidde Constructors, New York, state that this method of construction results in a saving in steel of 15 to 30 per cent for any given span.

For long spans, concrete arches and split I-beam steel arches have been successfully used.

Roof decks of pre-cast concrete slabs or ribbed steel are taking the place of wood. They are economical and do not shrink or curl up, a common complaint with wood.

There is a definite trend toward flat roofs, state Rosengarten & Kraemer, Philadelphia. Insulation, either blown in or laid on top of the roof deck, has proved its value in savings during the heating season, and in better working conditions during the summer.

8. Ceilings. In offices and finished areas, suspended ceilings of glass fiberboard, glass foam, vegetable fiberboard, and various acoustical tiles are in much favor. These ceilings are generally used with fluorescent troffer units.

9. Insulation. This is partially treated in Section 7, above.

The question of roof insulation is being studied on many jobs to determine the most economical type and thickness. Rosengarten & Kraemer point out that doubling insulation does not double savings. For example, the fourth one-half inch of insulation reduces heat loss only one-fourteenth as much as does the first one-half inch.

10. Heating. Use of floor panels designed for radiant heating is rapidly increasing. Cost of installation is coming down.

In large areas, unit heaters, and particularly the use of fresh-air type blower units, represent the most popular heating medium.

11. Ventilation and air conditioning. In many plants ventilating fan systems have been installed. They have been provided to form a part of the cooling and other air conditioning equipment in the event future occupancy or other conditions warrant the expenditure for atmospheric control.

The ease with which controlled atmospheric conditions can now be obtained in new plants has led many firms to adopt building designs which anticipate subsequent installation of refrigeration units, chemical dehumidifiers, air filters, and fans; and to supplement limited initial set-ups in which ventilating equipment and electrical load centers are located on platforms that form integral parts of the building. Where such equipment is incorporated at the outset, The Austin Company, Cleveland, points out that most of the air conditioning equipment is installed on the platform at floor level, and then raised into place with it.

Air conditioning is increasingly popular in office sections. It is compulsory in some process work.

12. Floors. A relatively recent innovation is the use of long-span, pre-cast concrete floor slabs. These slabs, where the floor area permits their use, represent definite savings. Installed slabs actually cost less than the construction of wooden forms for a concrete floor poured in place, Rust engineers report. This saving still obtains after a granolithic or other finish is laid over the slabs. The wood block floor retains its popularity.

13. Storage space. About one-third of all factory space is used for storage purposes, and it does not seem economical to pay $6 or $7 a square foot for it. More attention will be paid to the economical design and layout of definite warehouse space in the future.

14. Materials handling. Headroom is being increased in the newer plants to permit greater flexibility for future installation of overhead conveyor systems, and to permit full utilization of palletized tiering methods. Layout for the most effective handling is getting careful consideration.

15. Personnel and public relations. The efforts of industrial management to increase the comfort and safety of employees are significantly influencing new plant design throughout the nation. Shortage of labor, union requirements, and a generally more progressive attitude toward personnel have led to ex-

terior beautification, adequate and attractive sanitary facilities, and, in general, a new concept of the employer-employee relationship. Firms employing large numbers of people seldom fail to provide parking areas, lunch rooms and cafeterias, and recreation space both in and out of the building.

With cost such a dominant factor in current construction, it is not likely that we shall see any new excursions into unproved non-production expense under present conditions, cautions Albert Kahn Associated Architects & Engineers, Detroit. Where justified by the remote location of a plant, companies are making substantial investments in well-equipped cafeterias readily adaptable for auditorium use in connection with training or recreation programs. In some instances, special outdoor promenades and terraces are being provided for relaxation with minimum expenditure through the utilization of otherwise idle roof areas.

16. Interior painting. Important among additional design features, which have gained in acceptance, is interior color-harmony painting. Color codes, worked out after study of effects in relation to the production process, are being applied to increase safety, restfulness, and worker efficiency.

The studies have led to corridors of differently colored ceramic glazed walls, depending upon the source of the light and whether it should be reflected or absorbed. Monotony of large, gray brick wall areas has been relieved by pilasters of maroon color brick. There has been a growing emphasis on the use of muted greens, blues, and tans for psychological effect.

17. Sanitary facilities. Modern washrooms using steel stall partitions, circular washfountains, and improved sanitary fixtures are being located as closely as possible to working areas. There is an increasing trend toward separating washrooms from locker areas. Toilet facilities can save money for the employer by being located at convenient intervals throughout the plant, instead of in one large room.

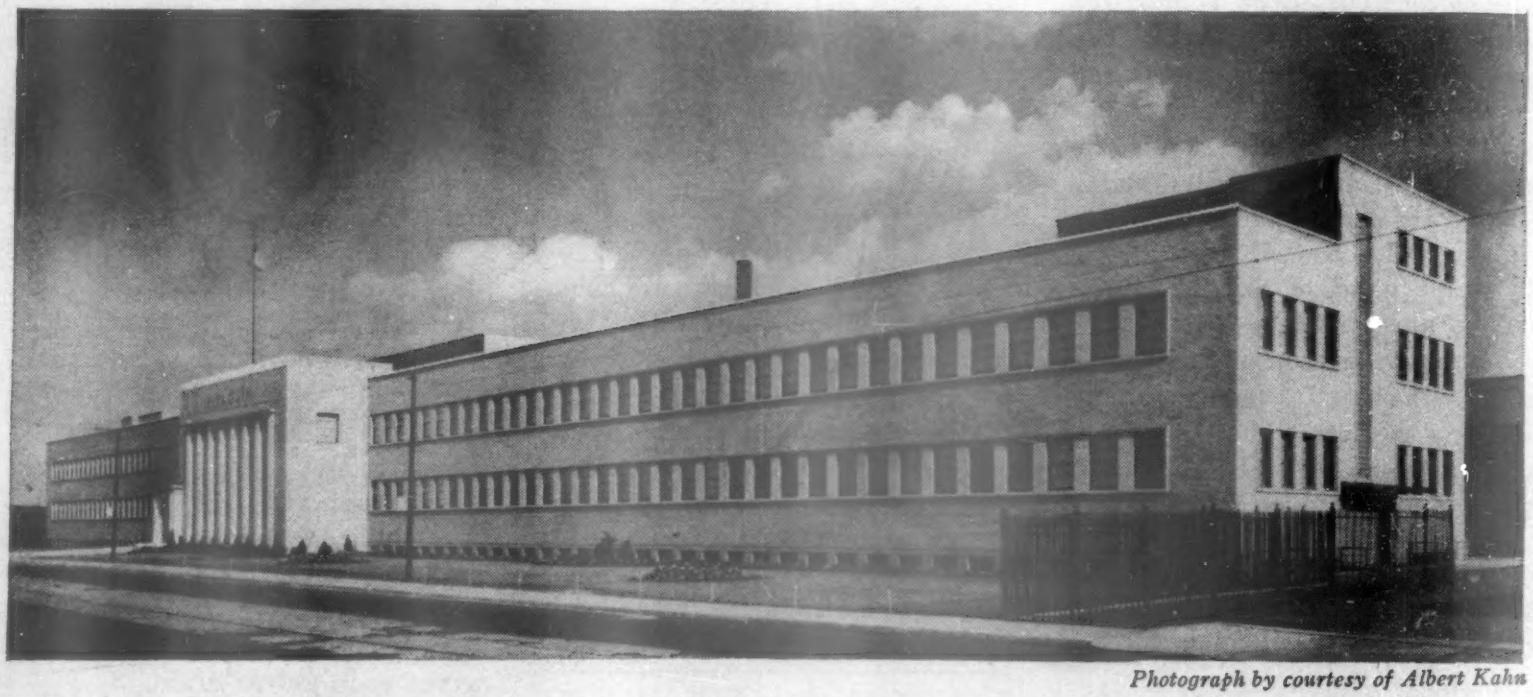
18. Employee circulation. While not a novel consideration, the efficient circulation of employees from parking lot to time clocks, from time clocks to lockers, and from lockers to work areas, is studied much more frequently than formerly in new plant design. Planning for the movement of employees entering and leaving work areas, including the convenient location of parking lots, and for worker circulation within the plant, is becoming an essential phase of engineering.

19. Landscaping. Landscaping and its proper maintenance have become recognized as a desirable expense, resulting in better public relations and employee morale. Landscaping has been influential in restraining zoning committees from banishing industry to uneconomic locations on the outskirts of cities where transportation and employment would be handicapped.

20. New materials. It is the consensus that aluminum is winning a position of greater importance as an industrial building material. Corrugated aluminum sheeting, first used for temporary Army and Navy construction when steel was scarce during war years, has been widely used in many of the new lower-cost buildings. Engineers expect to make greater use of new heavier post-war aluminum sheeting where such use is justified. Aluminum is also used in sash, lighting fixtures, and ornamental trim, although structurally it has not been employed to any extent.

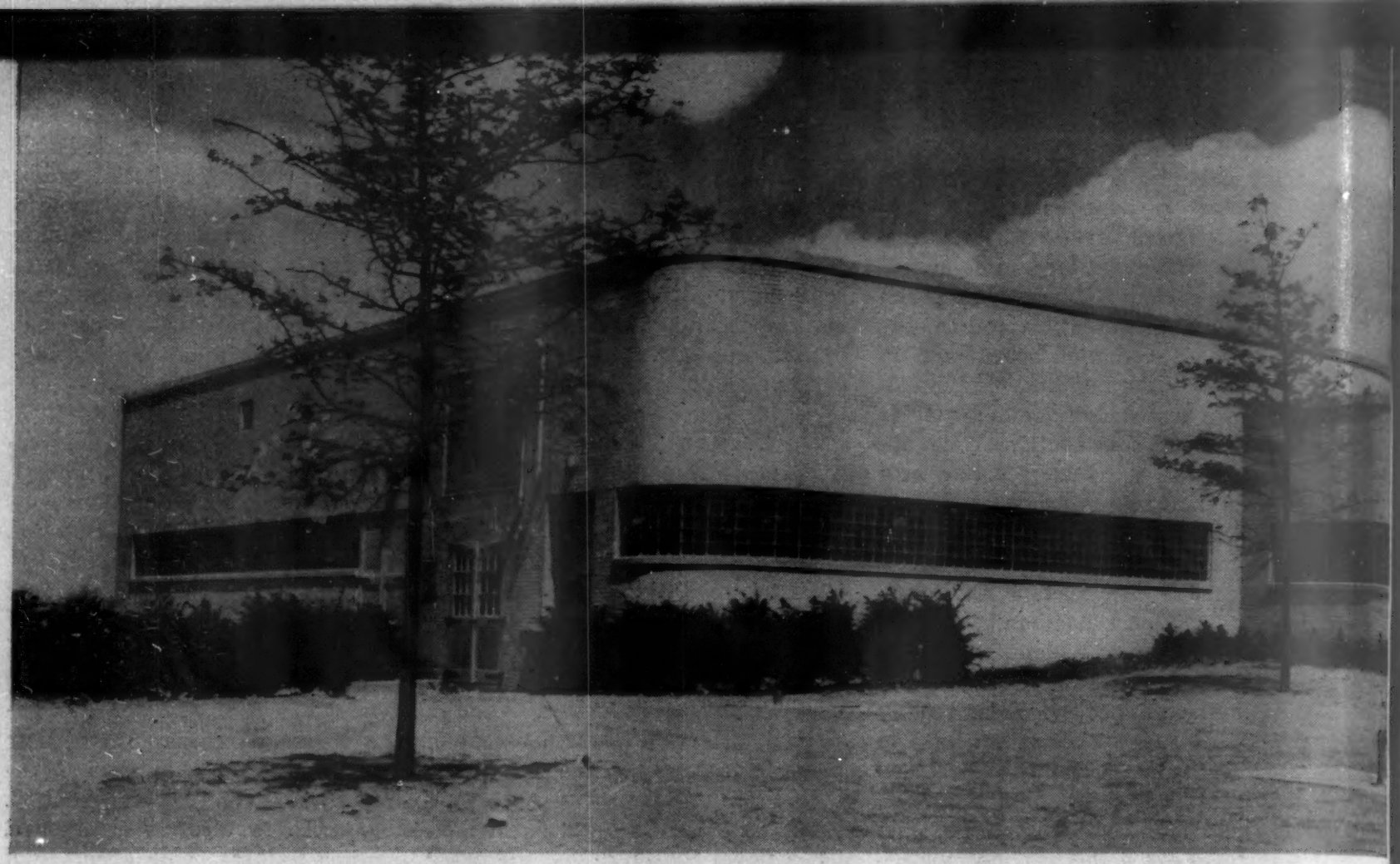
* * *

Factories to be built in the next few years, according to most of the experts, will not be much different from those that have been recently built, but they will in general be more expertly laid out for economical operation. The building needs will be more economically and more fully met. And the whole plant will be cleaner, safer, and more pleasant to work in.



Photograph by courtesy of Albert Kahn

PLEASANTLY LANDSCAPED office building of Plymouth Division, Chrysler Corporation, Detroit, was designed with an eye to good community as well as good employee relations. Radiant heating. Heat-absorbing glass on south side



BEST POSSIBLE WORKING CONDITIONS and efficient operation were primary considerations in planning Sapphire's new plant. Building is therefore air conditioned to provide 80-deg. temperature at tolerable 50 per cent relative humidity. Exterior walls

SAPPHIRE HOSIERY CORPORATION

NEW PLANT AT TELFORD, PA.

● One of the most beautiful of the post-war hosiery mills is that recently constructed at Telford, Pa., for the Sapphire Hosiery Corporation, manufacturer of women's full-fashioned nylon hosiery. Impressive are the buff-colored, 20-ft. brick walls of streamlined contour and the terra cotta blue facade in the center. Setting off the wall expanse is a five-unit band of 8x8-in. double-ribbed glass block.

There was reason underlying this plant's design. It was planned to embody the latest ideas in efficient operation and to bear out company policies in employee relations.

Main building. This building is 138x94 feet, with a temporary wall of frame construction at the rear, covered on the interior with ⅛-in. smooth asbestos board, and on the exterior with corrugated siding. Between the two surfaces is a 2-in. mineral wool blanket. The building has a 60x16-ft. office projection. Frame is of structural steel. Walls have a face-brick exterior with a 2-in. glass foam core and a concrete block interior.

Roof. Supported on steel columns, roof is built up on concrete planks with 2-in. glass foam insulation. Aluminum doors, fitted with prismatic glass, are set in a terra cotta facade and form the front entrance for employees and executives alike. Over the main entrance, which leads directly into the office wing, the name of the company appears in satin-finish aluminum cut-out letters. Terrazzo floors in the vestibule section have a sunken mat recess.

No interior columns. Of single-story construction, the 14,000 square feet of floor space is divided into 60-ft. clear spans. Clearance to the suspended acoustical ceiling is 11 feet. The floor in the manufacturing area is reinforced concrete on sand fill; in the offices, asphalt tile on concrete. The manufacturing floor is especially designed to withstand the weight of the latest type of long-section knitting machines.

No window sash were employed in construction. Glass block is used throughout. A condensation gutter, necessary under conditions of controlled high humidity, drains all glass block wall areas. A dry well serves each gutter drain.

Lighting is by continuous, troffer-type, fluorescent fixtures. Lighting

---

Architect and Engineer: Lockwood Greene Engineers, Inc., New York

are buff-colored face brick set off by five-unit band of glass block

CONTINUOUS TROFFER-TYPE FLUORESCENT FIXTURES supply 50 foot-candles of light at work level. Acoustical ceiling. No columns; 60-ft. clear span

CONDENSATION GUTTER takes care of moisture on glass block wall areas caused by controlled humidity. Drain hole (marked by arrow) leads to dry well

intensity at the working plane of the knitting machines is 50 foot-candles. Other areas have between 25 and 35 foot-candles.

Partitions are concrete block. Walls are sapphire blue, ceilings are white, office floors are dark red. Walls are plastered in the seaming and looping department, women's lounge, restroom, men's lounge, offices, and corridors.

Air conditioning. Because of the nature of the product, air is conditioned to provide a temperature of 80 degrees at 50 per cent relative humidity. Distribution is through concealed ceiling ducts. By positioning the outlets, conditioned air is directed to the knitting machines. A mezzanine with a boiler room provides space for the air conditioning blower equipment, thus leaving the floor area clear for manufacturing purposes.

Electrical distribution. Conduit are used; 440-volt power lines are under floors; lighting cables are in the ceiling. All other distribution lines are concealed. The better developments in light and power equipment are being used. For instance, power panels are of the circuit breaker type. The air conditioning system is controlled by a central panel which incorporates combination starter and circuit breaker equipment. All motors have individual lines from the various power panels.

This is said to be one of the first hosiery mills with a "packaged" boiler plant. It contains automatic oil-fired boiler equipment, this type having been selected in order to eliminate the necessity for a full-time fireman.

Wet-type automatic sprinklers with pendant heads extend below the suspended ceiling for interior fire protection.

Shipping platform. A covered platform gives weather protection to employees and product. Service roads are paved with bituminous macadam.

The finished-goods storage room is located at the extreme front of the building, adjacent to the receiving and shipping platform and to the business office.

The women's lounge, located to the right in the office wing, has a color scheme of coral with deep mottled asphalt tile flooring. Heating grills are concealed. Toilets for men and women have tile wall wainscot and terrazzo floors. Metal coat racks are used for employees' garments.

Landscaping and lawn occupy the 40-ft. space between the plant and the street.

MANUFACTURING SECTION is one-story monitor-type building with cinder block walls and steel sash. Assembly hangar (far left) has 12-ft. band of windows. Two-story administration building (right) is stuccoed; has asphalt tile floors, acoustical tile ceilings,

PIASECKI HELICOPTER CORPORATION

NEW PLANT AT MORTON, PA.

● This plant was designed specifically for straight-line production of large helicopters. At present, Piasecki twin-rotored HRP-1 "Rescuers" are being built there for the Army and Navy.

Four requisites governed selection of the site:

1. Nearness to previous location.
2. Good transportation facilities.
3. Plenty of growing room.
4. Adequate flight space.

Morton is near the previous location, and 20 minutes from the heart of Philadelphia. Located 400 feet from a railroad station on a 55-acre tract of land, Piasecki has room for future expansion and plenty of available flight space.

The plant is divided into three parts—a two-story administration and engineering building, 140x50 feet; a one-story monitor-type shop building, 400x100 feet, and an assembly hangar of like construction, 50x100 feet.

Steel truss construction with cinder block walls, steel sash, concrete floors, and metal roof deck characterize the factory buildings.

Factory buildings. In the 45,000-sq.-ft., one-story section, column spacing is 50x20 feet. Assembly area is of monitor construction with operating sash on both sides for a distance of 400 feet. This area has a clear height of 18 feet, to accommodate 16-ft.-high welding jigs. The assembly hangar, located at the far end of the shop area, has an unobstructed height of 24 feet, and a set of three large doors which, when opened, give a door opening of 24 feet high by 50 feet wide. This provides room for entrance and exit of large transport helicopters with blades fully extended. This area is extremely well lighted. It has a 12-ft. band of windows around the periphery of the assembly hangar.

Roof construction is of steel deck and fiberboard insulation with a 15-year bonded felt seal. Partitions are asbestos board on wood studding. Ceilings and walls are painted white, with maroon dado, sash, doors, and trim.

Heat, light, ventilation. Two oil-fired, 60-hp. boilers are located in a boiler room which adjoins the main plant. They are connected to a unit blower-type heater system in the factory area, and to radiators in the administration and engineering areas. The medium of heat is low pressure steam at 5 p.s.i.

Fluorescent fixtures provide 30 foot-candles at work level. Operable sash in plant provide ventilation.

Overhead cables carry 110- and

Architect and Engineer: Rosengarten & Kraemer, Philadelphia

exhaust system. Fluorescent lighting—30 foot-candles in shop, 40 to 50 in offices

UNIT HEATERS attached to trusses keep production area warm. Steel-deck roof with fiberboard insulation. Good natural light plus fluorescent. White walls, maroon dado

220-volt current. Water pipes are carried overhead; steam lines run along interior walls.

Employee facilities. Lunches are distributed to workers throughout the plant by a mobile lunch cart. A baseball diamond and a piano provide recreational facilities for employees in the lunch hours.

Medical facilities for approximately 1000 employees include a modern dispensary equipped with a bed, sterilizer, and first aid supplies. A registered nurse is in charge.

Two parking lots provide combined space for 300 cars.

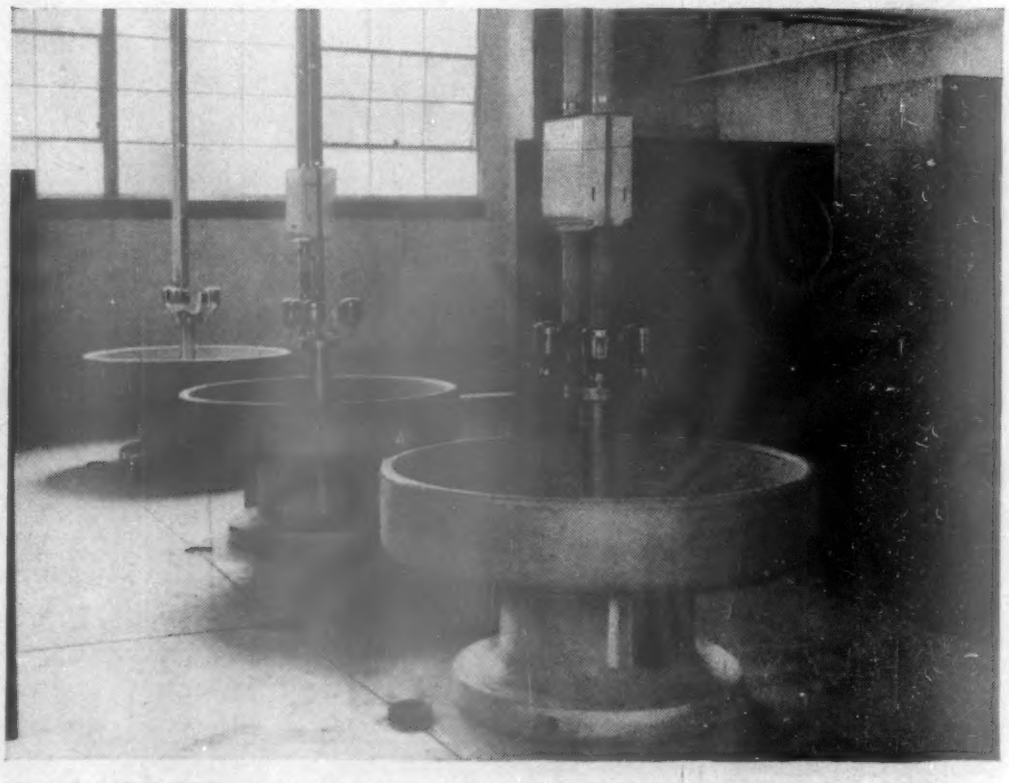
Surrounding the production area is a cyclone-type fence. Around the rest of the area, a 2300-ft. farm-type fence has been erected. Landscaping will be completed this spring. A 30x400-ft. roadway runs from a highway to the receiving entrance.

Administration and engineering building. Of basically the same construction as the factory, the administration and engineering building, with 15,000 square feet of space, has several refinements. Concrete floors are covered with asphalt tile. Column spacing is 25x20 feet. An air space between the hung plaster ceiling and the roof provides insulation. Cinder block walls are plastered on the inside, stuccoed on the outside. Ceilings and walls are sand colored; sash, doors, and trim are maroon.

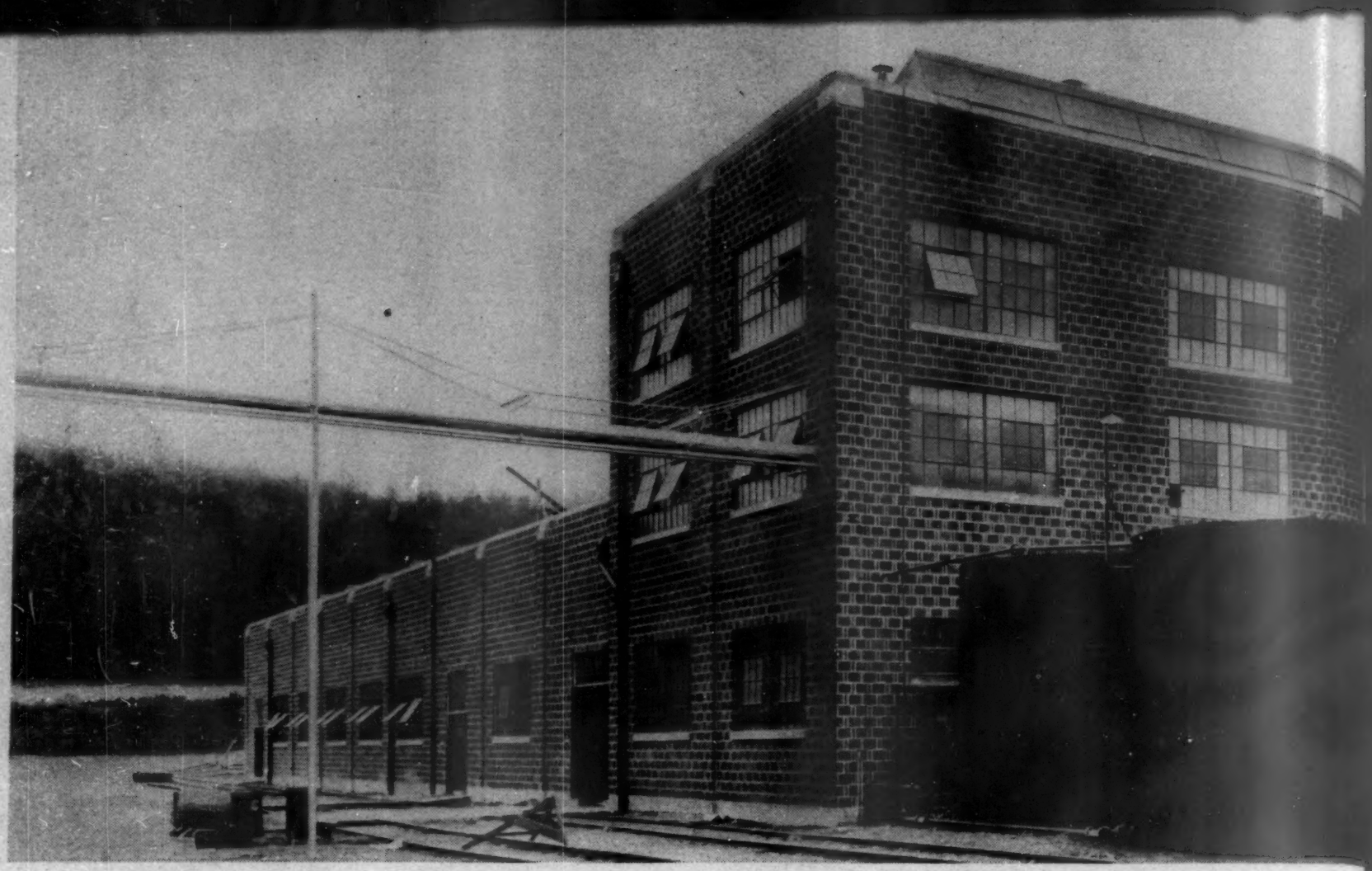
Fluorescent fixtures provide 40 to 50 foot-candles. Fixtures in the executive offices are recessed. This building is equipped with operable window sash and a metal duct exhaust system to provide ventilation. Ceilings are treated with acoustical tile. And ceiling height is 9½ feet.

Several conference rooms have been provided for company-conducted educational programs.

Protective devices. The plant is completely sprinklered throughout, and four fire hydrants are located immediately adjacent for use in fighting fires that might possibly occur on the roof or outside the plant.



HUMAN FACTOR not neglected. Locker room is equipped with circular wash fountains and individual steel lockers. Company also provides good medical facilities



UNPAINTED HOLLOW TILE was used for sidewalls and partitions in one-story cell building (left) and three-story evaporator room (right). Roofs of both buildings are pre-cast concrete slab with 20-year, three-ply coverings. Sawtooth-type monitors. Steel sash

PENNSYLVANIA SALT MANUFACTURING

NEW PLANT AT PORTLAND, ORE.

● Continuous production of caustic soda, liquid chlorine, and DDT, utilizing gravity flow to the greatest extent. That was the goal of Pennsalt engineers in designing this three-unit plant for construction at Portland.

Unusual is the fact that all chlorine and caustic soda production, excepting chlorine liquefaction, is under one roof.

This plant, built around specific processes, complements other Pennsalt facilities located nearby along the company's deep-water frontage on the Willamette River.

Construction. The three main buildings utilize concrete, tile and steel. The combined floor area of 42,000 square feet is surfaced with concrete. The roof is pre-cast slab with a 20-year, three-ply covering. It is of continuous-light, sawtooth-type construction with supporting steel trusses.

Sidewalls and partitions are constructed of unpainted hollow tile. Steel sash are used throughout all sections.

Ceiling and structural members are painted aluminum; color on equipment varies with its function; trim is green.

Heat and light. Unit heaters are used to provide heat. General illumination of 15 foot-candles is obtained with incandescent fixtures and is supplemented with natural light. Spotlighting is utilized on certain equipment.

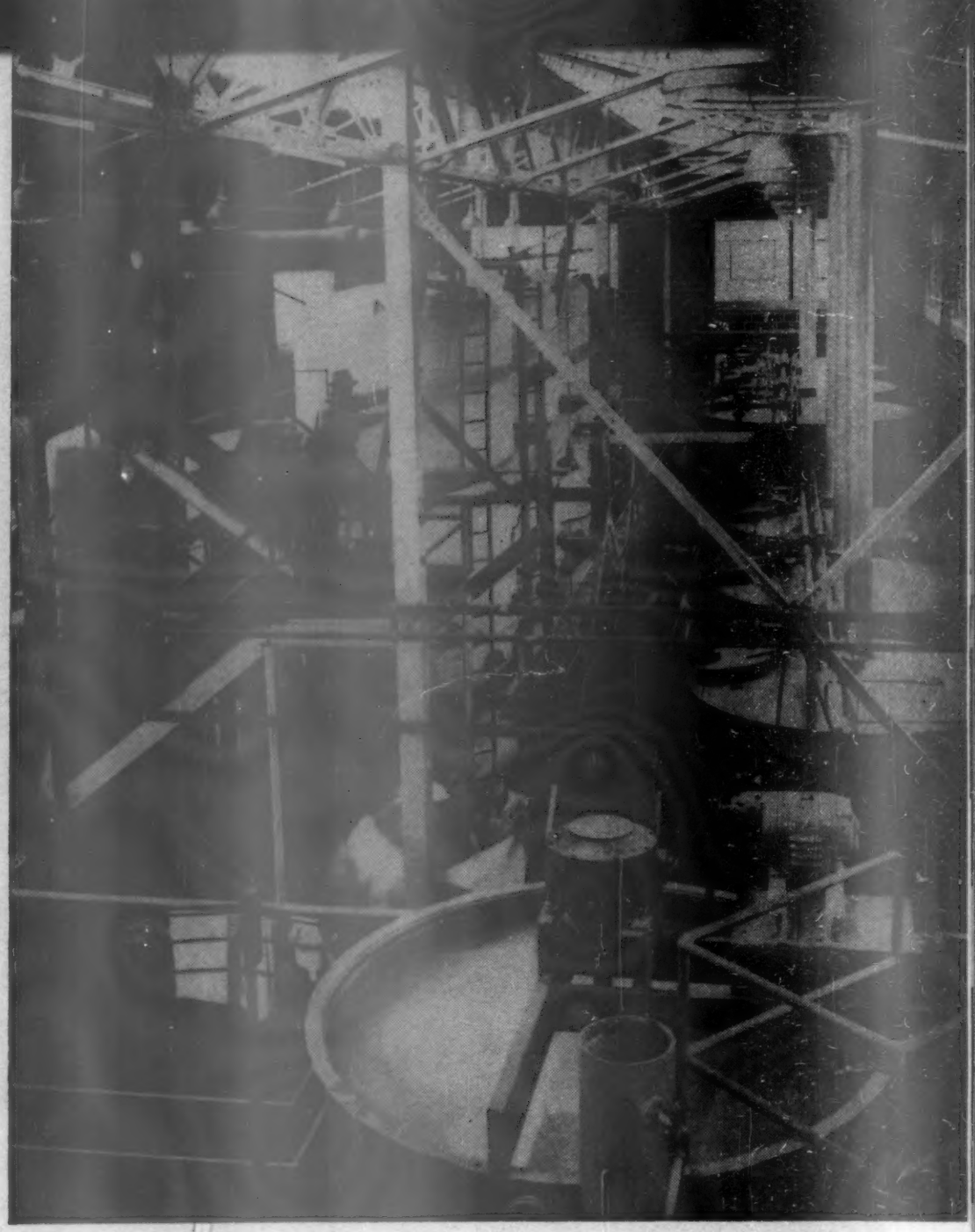
Engineer: Pennsylvania Salt Manufacturing Company

Ventilation is natural through roof vents, except in the chlorine cell room tunnel which carries air, steam, and gas lines. There, and where small containers are filled with liquid chlorine, fans are brought into use.

Electrical distribution. Cables in overhead conduits are used. Power for motors is supplied at 440 volts. All lighting and controls are 110 volts. Power for the electrolytic production process is provided by Bonneville Dam. The current is converted from 13,800-volt a.c. to 365-volt d.c. by mercury-arc rectifiers. Constant load factor is maintained by automatic control which assures a constant flow of current to cells regardless of fluctuations on the incoming power lines.

Water is transported under-

is used throughout. Tanks are used to store 50 per cent liquid caustic soda



NATURAL LIGHT from continuous sash in sawtooth roof and windows in sidewalls is supplemented by incandescent lighting. Ceiling and structural members are finished in aluminum paint; trim is green; color on equipment varies with function

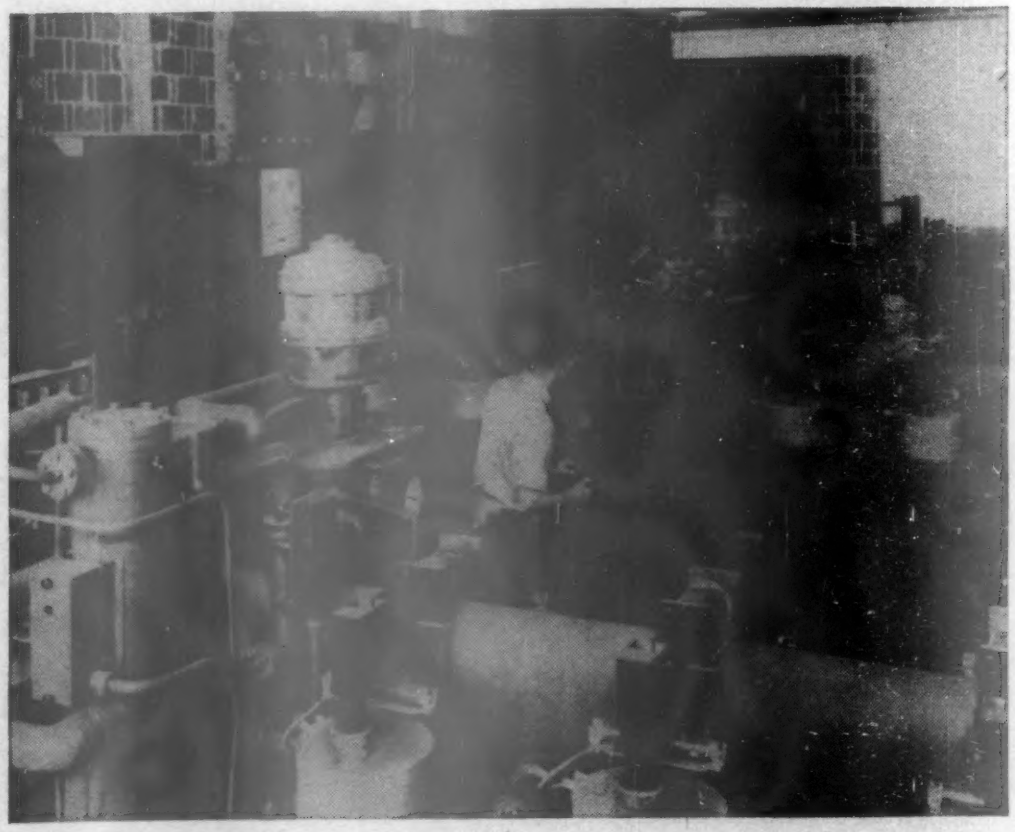
COMPANY

ground outside the buildings, and overhead inside. Steam and air lines are all overhead.

Transport. Because of available deepwater advantages, Pennsalt constructed a timber dock for ocean-going supply vessels. Salt, a basic raw material, comes in by water. Two sidings provide railroad access. One 5-ft. hydraulic lift has been installed. Cranes do heavy in-plant moving, while drums are handled by fork lift trucks. There are four traveling cranes and five monorails in use in the plant.

Employee facilities. Showers and locker rooms are included in the sanitary facilities.

Surrounding the plant is an 8-ft. cyclone-type wire fence. Ample parking space for employees' cars is provided outside the main gate. Serving all buildings in the plant is a 20-ft. asphalt road.



RECTIFIER ROOM has hollow-tile walls that characterize other units. Here four mercury-arc rectifiers convert a.c. power at 13,800 volts to d.c. power at 365 volts

BUILT AROUND PRINCIPLES OF SUSPENDED ASSEMBLY, WHICH WAS APPLIED HERE FOR FIRST TIME IN AUTOMOTIVE INDUSTRY

GENERAL MOTORS CORPORATION

NEW PLANT FOR CHEVROLET-FLINT DIVISION

● Ten acres of plant area. Nineteen acres of assembly area. "Suspended assembly," employed for the first time in automobile construction. Power-and-free conveyor system. Two and a half miles of conveyors and monorails. Seven miles of fluorescent light tubing. Fourteen paint mixing and circulating systems.

There's a thumbnail description of the new Chevrolet-Flint Assembly Plant and Fisher Body Flint Plant No. 2 on the outskirts of Flint, Mich.

Ten buildings—1,269,000 square feet of floor space—are situated on 104 acres of suburban property.

Assembly building. The assembly building is of structural steel frame, has two stories and a partial basement. The second floor is of concrete supported on steel trusses. Monitor roof has steel trusses, steel purlins, and is protected with cement tile and composition roofing. Roof expansion joints run in four cardinal directions. Enclosing walls are of concrete, brick and steel sash. Interior walls are of brick, with the exception of the inside finish of the enclosing walls on all utilities,

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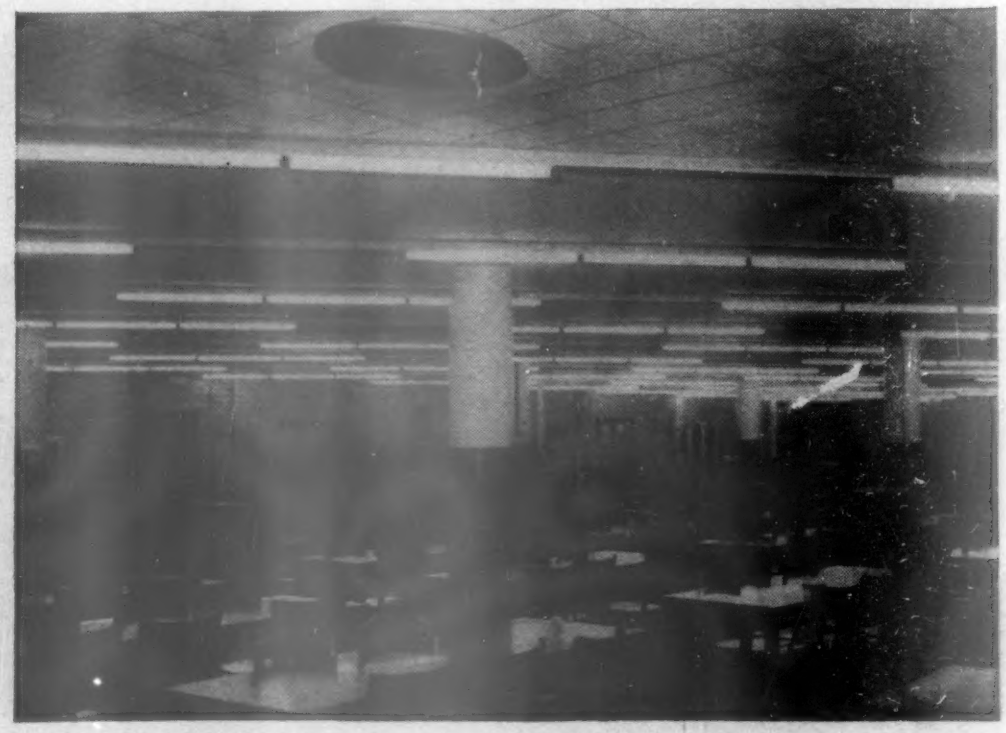
Architect: Albert Kahn Associated Architects & Engineers, Inc., Detroit

CIRCULAR LOBBY is well-planned and lighted. Receptionist's desk is in center. Recessed fluorescent lights enhance attractive design of room

FIRST AID ROOM resembles modern hospital in appointments and appearance. Metal and glass partitions are used. Walls are tile; floors, asphalt tile



CAFETERIA IS SPACIOUS, air conditioned, well-lighted, and equipped to handle 800 employees at one sitting. Service counter extends around wall in background

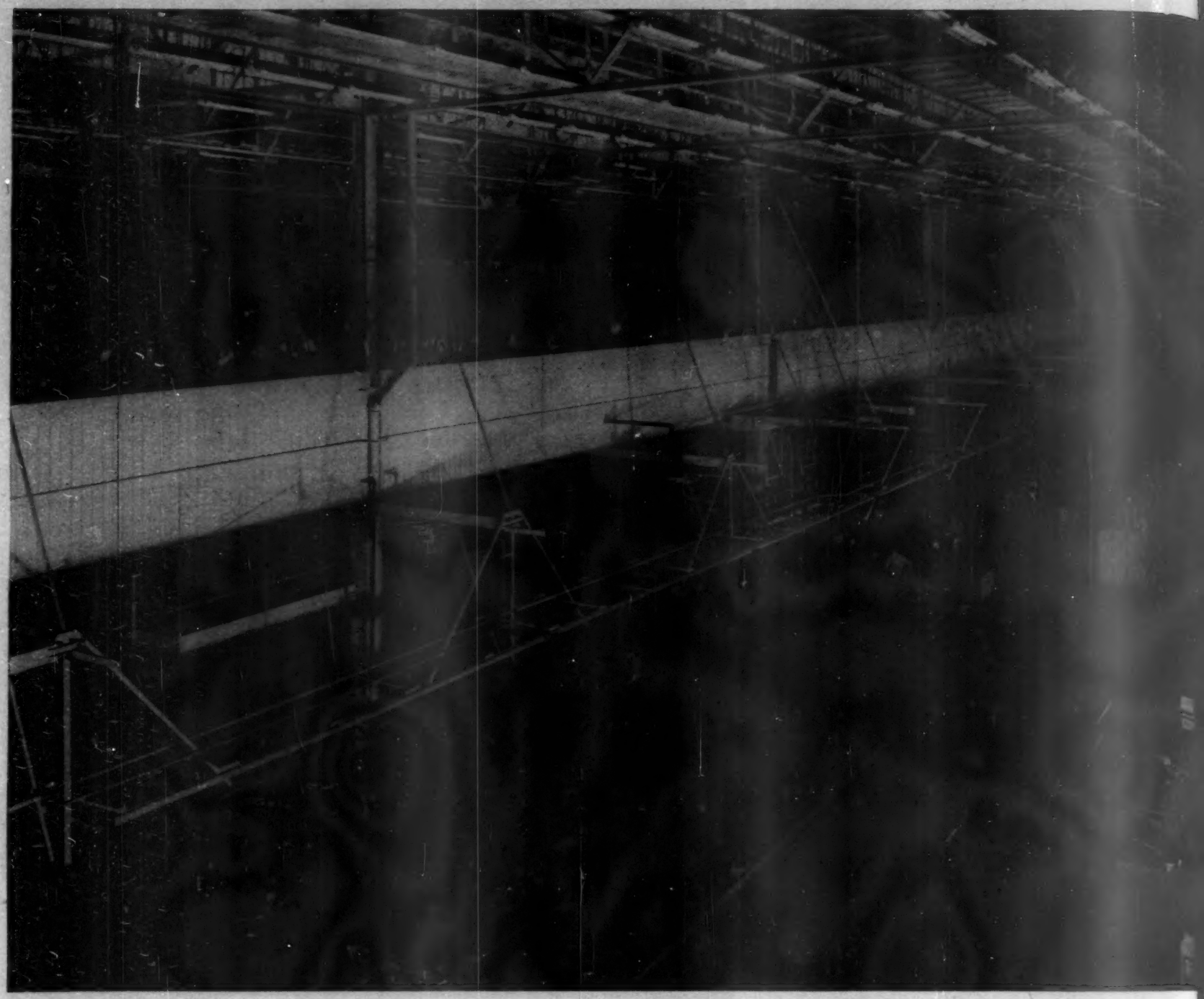
kitchen, and cafeteria, which are lined with glazed tile.

Floors are concrete, finished with wood block or mastic. Column spacing is 50x50 feet, with a 150x60-ft. bay running the length of the building. Clearance to lowest chord is 16 feet on first floor, 14 feet on second floor, 37 feet in high bays. Sash are continuous pivot type with gang operators.

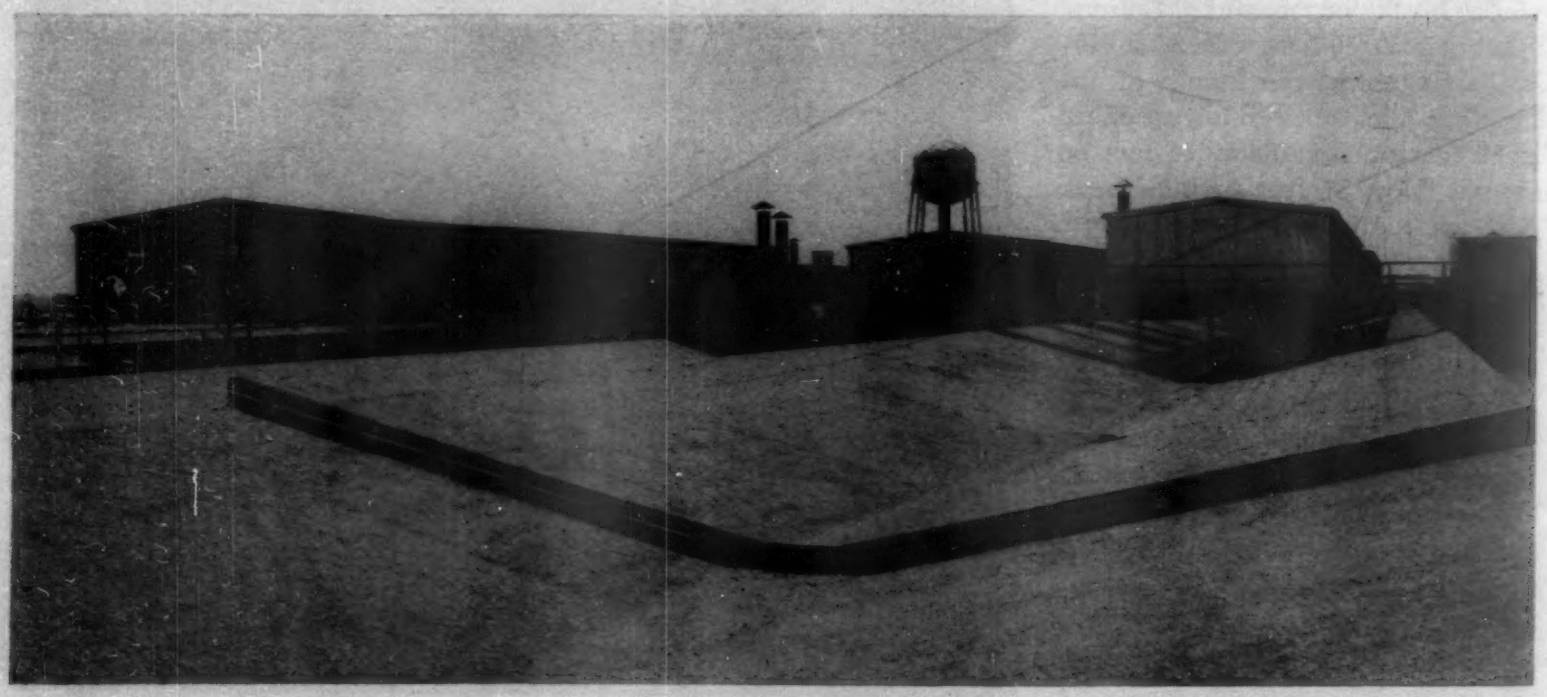
Partitions are of common brick and cement block; glazed hollow tile in kitchen, cafeteria, laundry, shower, and toilet room; metal and glass in first aid and personnel sections, and in elevated washrooms.

Eye-saving colors have been used throughout the plant. Above a green dado, walls and trusses are white. Sash and trim are dark green; metal partitions, light gray.

Materials handling provisions. Three railway tracks for the de-



TWO-STORY manufacturing layout utilizes mezzanine. In foreground, frames are suspended from monorail. Another mezzanine is on opposite side of high bay. Second floors are devoted to paint and trim operations, truck cab building



ROOF MONITORS support elevator penthouses, fan platforms, oven. Composition roofing covers cement tile deck on steel trusses and purlins. Expansion joint in foreground. Water tower is located beside boiler house at rear of assembly building

BOILER ROOM, showing hopper-fed boilers. Note easily cleaned tile floors and walls, and ample natural lighting from large windows in wall and monitor

TUNNEL FROM POWER HOUSE carries steam pipes to assembly plant. Tunnel is equipped with adequate lighting, sprinkler heads, and wide walkway

livery of materials enter the building, with spur tracks to the boiler house and pump houses Nos. 1 and 2. Two storage areas have been provided for finished automobiles, one for truck haulaway, one for customers' delivery.

Eight elevators serve the plant; three are hydraulic. Of the eight, six serve the second floor, the other two, the basement areas. A 7x200-ft. concrete truck ramp has been provided on the Fisher side from first to second floor.

In general, the "suspended assembly" principle of construction has an advantage in improved employee relations. It reduces operator fatigue. Instead of moving at floor level, automobile frames are suspended from overhead monorails which bring work to employees on the line at bench height and permit free access from all sides.

Employee facilities. Complete facilities have been provided for handling, preparing, and serving food in the basement of both the Chevrolet and the Fisher areas. These include storage, meat, vegetable, dairy, and salad refrigerators; bakery, sandwich, and salad preparation; dishwashing; two service counters; and employees' washroom and locker facilities.

Washrooms are located at various areas throughout the building. Those in the Fisher section are on the first and second floor levels, with glazed hollow-tile walls, metal stall partitions, and wash fountains. Those in the Chevrolet section are elevated or mezzanine-type enclosed with metal partitions and reached by first and second floor employees via steel stairs.

Locker rooms are located off the main basement corridor and have wash fountains, dressing and shower rooms, and toilet facilities in both Fisher and Chevrolet areas.

Chevrolet first aid and personnel sections are combined and located in the basement area. First aid includes examination rooms, X-ray, operating, physio-therapy treatment, ward and waiting rooms. Walls throughout first aid are glazed hollow tile, lead-lined at X-ray. Floors are ground finished. Ceilings are suspended.

Employees' parking areas, com-

prising 250,000 square feet of space, have black-top paving and floodlighting. Since the assembly building houses both Chevrolet and Fisher divisions, parking facilities were placed for these employees at north and south sides, respectively. Employees enter their respective sections through a control house, thence through a tunnel to the basement facilities, which include individual steel lockers, washrooms, and tiled showers.

Grounds. Factory-type wire fences with three strands of barbed wire at the top have been installed. Both swing and sliding gates are in use on the property. All main roads throughout the plant, including test track and entrance roads to parking areas, are concrete, 22 feet wide. Secondary roads which lead to storage areas are black top, 10 and 22 feet wide.

Office building and garage. The 300x52-ft. office building, of reinforced concrete, houses all administration units of both Chevrolet and Fisher. It comprises two stories and a basement, and is connected to the main assembly building by a garage for executives' cars. Walls are of brick, with stone trim. The central entrance is of stone, with steps of granite.

All sash used are of projected-type steel. Interior finish consists of plaster walls, acoustic ceilings, recessed fluorescent fixtures, and asphalt tile floors. Office partitions are metal sash. Utility rooms, cafeteria, and kitchen are glazed tile with ceramic floors, except that quarry tile floors are used in kitchens and behind service counters.

The garage, 60x88 feet, is of steel frame construction; is provided with monitor ventilation. Walls are of brick; sash, steel; floors, concrete; and roof, cement tile.

Customers' delivery building. A 200x252-ft. customers' delivery building, consisting of a car service section and a waiting room, is of one-story structural steel frame construction with cement tile roof. Enclosing walls are of brick and steel sash.

Function of this building is the servicing and installation of accessories on cars for delivery to those customers who have made arrangements to take delivery at this point.

Interior finish of waiting room consists of plaster walls with wood-paneled wainscot, acoustic ceiling, recessed fluorescent lighting fixtures, and asphalt tile floor. Restrooms have plaster and ceramic tile walls with terrazzo floors.

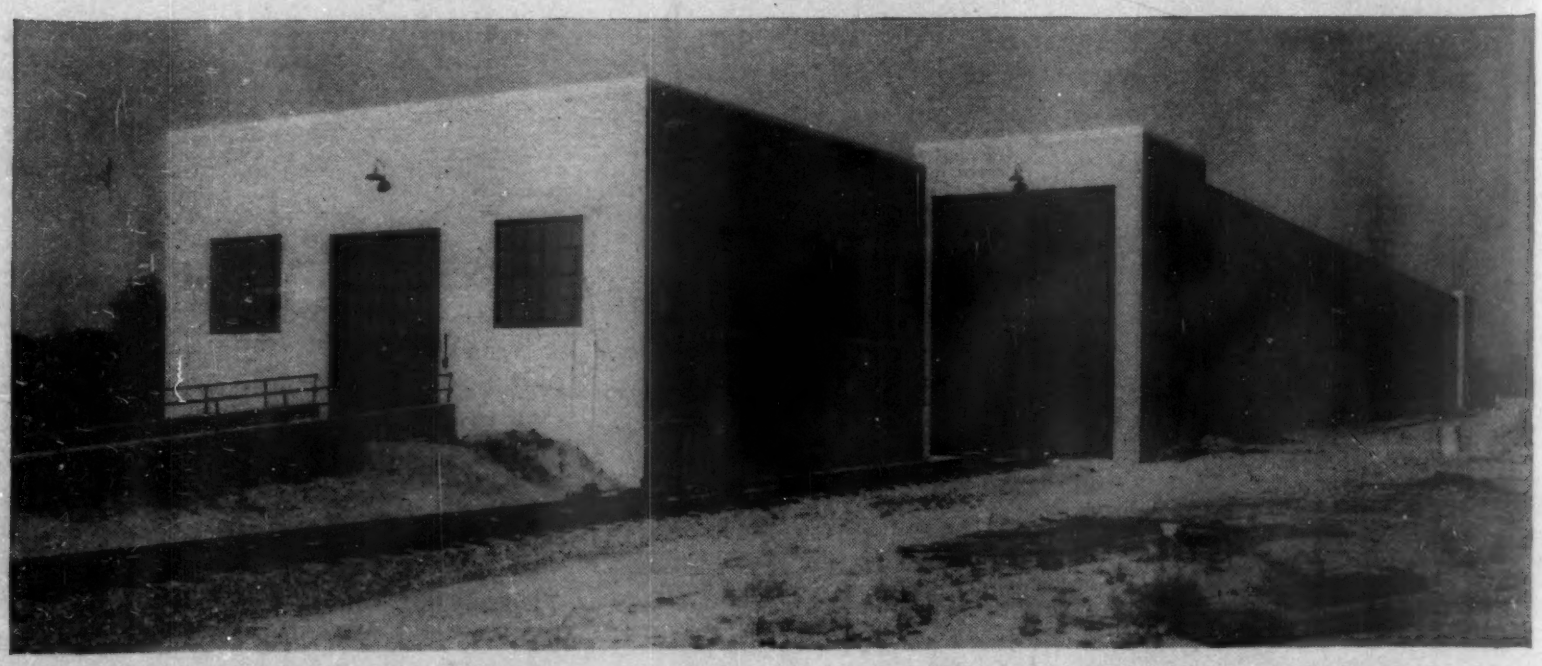
The car service section has a concrete floor with complete facilities for servicing cars and installing accessories. Restrooms, washrooms, locker, and lunch rooms have been provided in these areas.

Car-loading building. A 376x81-ft. car-loading building is of one-story structural steel frame construction, enclosed with steel sash and brick walls. It has a cement tile roof. Lighting fixtures are the fluorescent type. Function of this building, which is served by a concrete ramp at either end, and two recessed, interior railroad tracks, is the loading of finished automobiles into freight cars for shipment by rail. Weight scales and wash racks have been incorporated in the building.

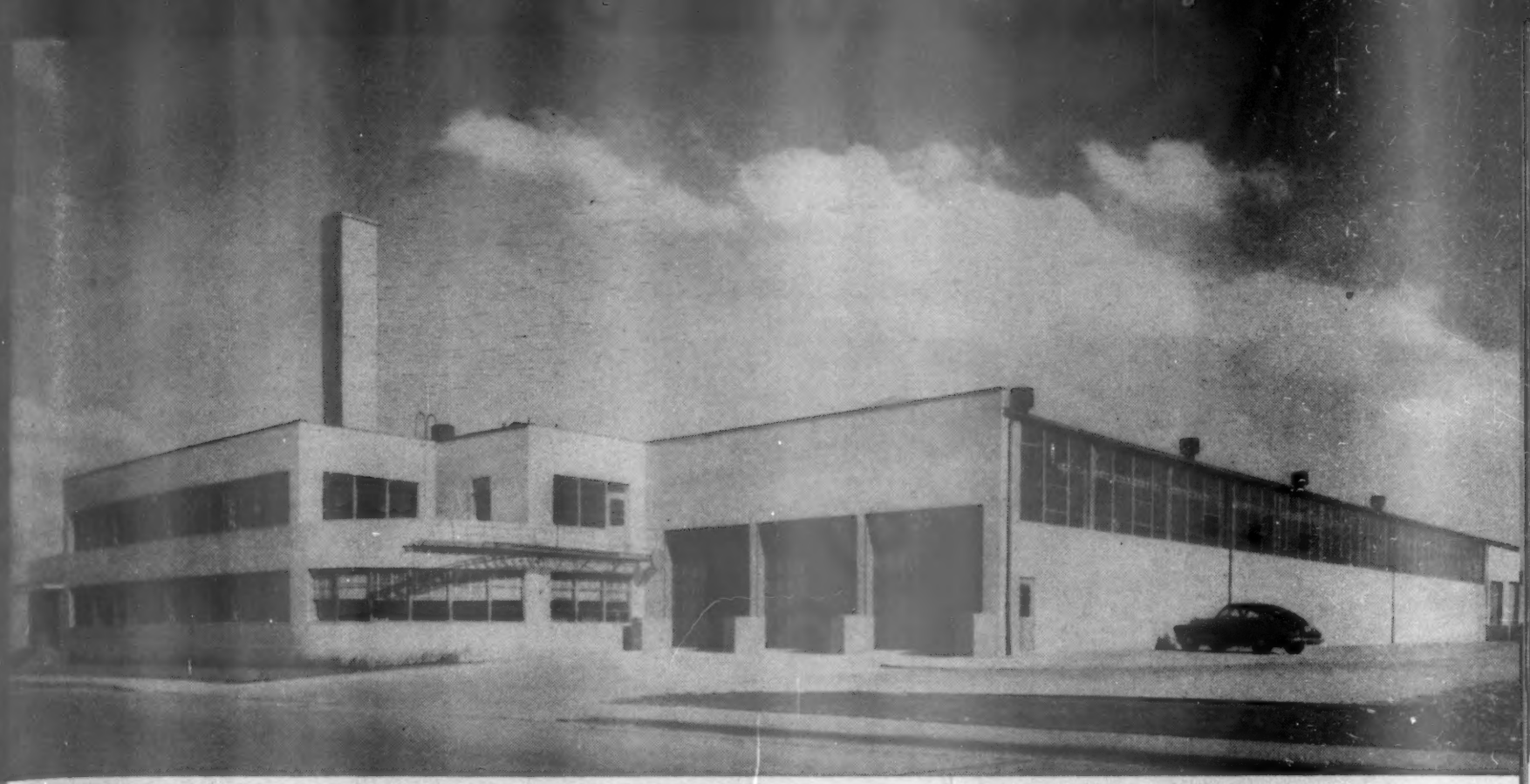
Shipping building. The 50x50-ft. shipping building has been located adjacent to end of the test track and car storage area for the final inspection and minor adjustment of vehicles. Entrance and exit doors are motor-operated, electric-eye controlled, and open and close as vehicles travel over the inspection pits. The building is constructed of brick, steel sash, and structural steel frame with a cement tile roof.

Other buildings. Pump houses Nos. 1 and 2 with tank farms, and an acetylene building have been provided adjacent to the assembly building for receipt, storage, and distribution of oils, gasoline, grease, and flammable materials to various points in the main building.

These buildings are concrete with explosion-type metal deck roofs. Storage tanks are buried and have concrete supporting mats. A concrete tank vault has been provided adjacent to one of the pump houses for certain oils.



CAR-LOADING BUILDING HAS AUTOMOBILE RAMP AND ENTRANCE AT LEFT, ALL-WEATHER RECESSED SHIPPING PLATFORM AT RIGHT



PLENTY OF PROOF HERE that a warehouse can be functional and beautiful. Two-story section at left contains air conditioned offices. Building is of steel frame construction with face brick walls and steel sash. Efficient use is made of vertical storage space

CRUCIBLE STEEL COMPANY OF AMERICA

NEW PLANT AT CHICAGO

● Despite high construction costs in 1947, the new warehouse built in Chicago for Crucible Steel Company of America has resulted in considerable savings to the company. Five features account for efficient operation:

1. The warehouse is designed for straight-line flow of materials.

2. Mechanization for steel handling is complete.

3. Storage layout and facilities are especially designed to utilize vertical space.

4. Warehouse and offices were planned to incorporate completely functional designs.

5. Excellent working conditions were engineered into the plant and offices.

Warehouse. Designed for storing and merchandising specialty steels, it features sale of steel on an over-the-counter basis, cut to size for the purchaser.

Steel-frame construction is used with brick enclosure walls and steel sash. Exteriors are face brick. A heavily reinforced concrete floor treated with hardening material carries the extremely heavy warehouse load.

Bays are 50x20 feet. Clearance from floor to lowest chord is about 20 feet, while the distance from floor to the high point on the ceiling is 30 feet.

Overhead 3-ton electric hoist cranes enable mechanical handling over the entire floor area, from the time uncut steel is unloaded from rail cars on an interior siding at one end of the building, until it is sold, cut to size, and placed in outgoing trucks at the opposite end.

Special A-racks in which long bars of steel are stored standing on end, rather than lying flat, have been provided.

Bars are moved in and out of racks by crane, eliminating hand lifting formerly required with horizontal racks. Through use of cranes and the vertical stacking method, a bar of steel can be taken from storage in 1¼ minutes. With horizontal stacking and removal by hand, the same operation required 4 minutes. Banks of horizontal racks hold the shorter and lighter steel bars and other products.

Equipment for cutting steel to order was located where it would not hinder normal warehousing operations. This was accomplished by decentralization of cutting machines in close proximity to various storage

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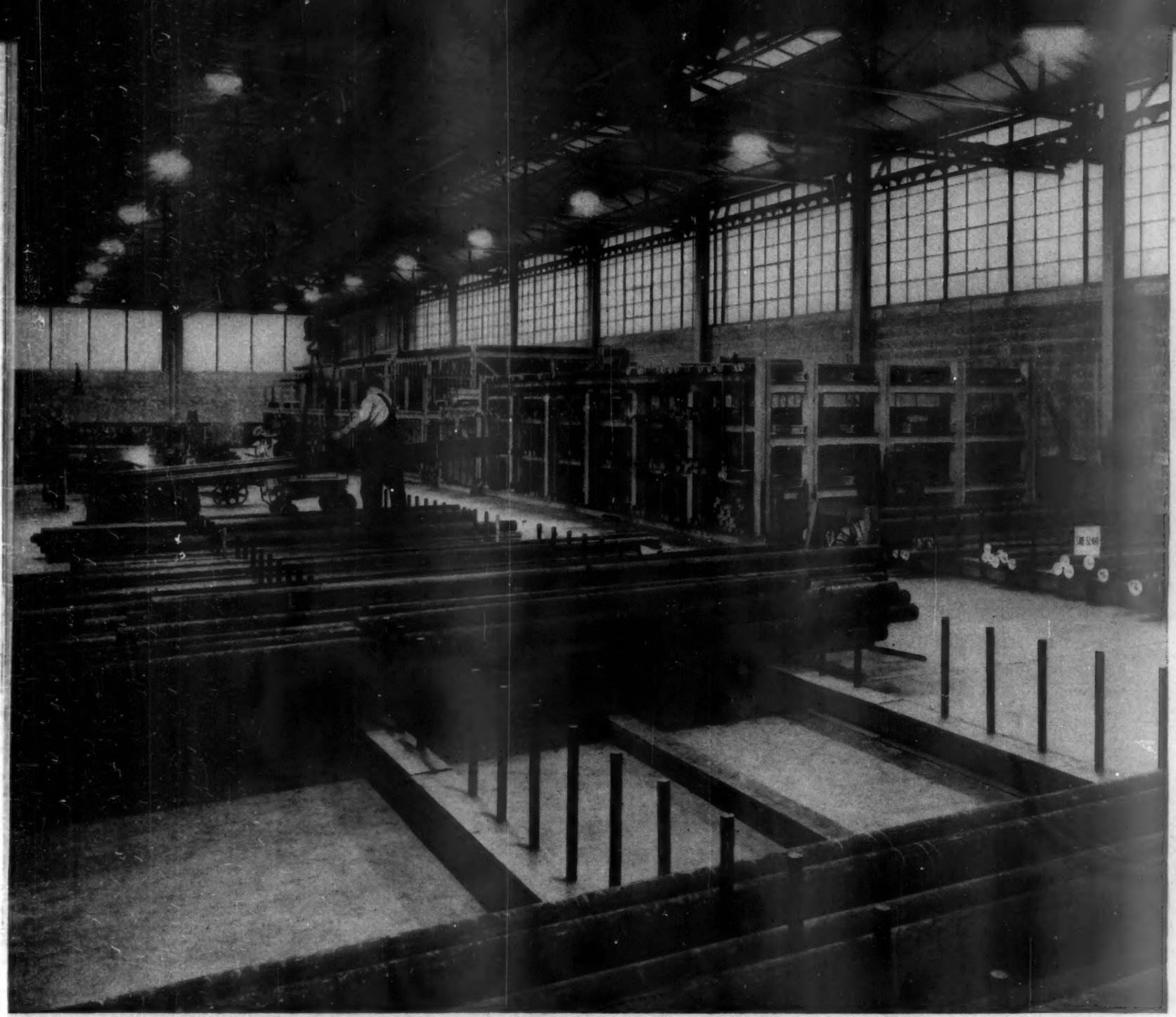
Engineer: Guy B. Panero, New York
Architect: W. Stuart Thompson & Phelps Barnum, New York



BUILT AROUND THE PROCESS may truly be said of new Crucible Steel warehouse. Steel is handled mechanically from time it enters warehouse until it is sold over the counter. Three-ton cranes cover entire floor area. Double skylight in roof and continuous steel sash provide good daylighting which is supplemented by high-bay RLM incandescent fixtures

stacks, thus allowing straight-line material flow and eliminating any back and forth movement required with a central cutting room. Tests made by the company have shown that mechanization has increased efficiency at least 30 per cent.

Construction. Interior construction utilizes steel columns, floor beams, and roof trusses; brick walls; and concrete floor arches.

Roofing is built up over 2½ inches of poured gypsum. Steel sash are used throughout. Steel structural members are painted gray; sash, doors, trim, and exterior metal are deep aqua.

Lighting is accomplished by high-bay, RLM incandescent fixtures; 10 foot-candles are provided for general illumination; 15 foot-candles at machines.

Fans in roof ventilators provide adequate ventilation. Electric service is by conduit-contained wiring in floors and overhead.

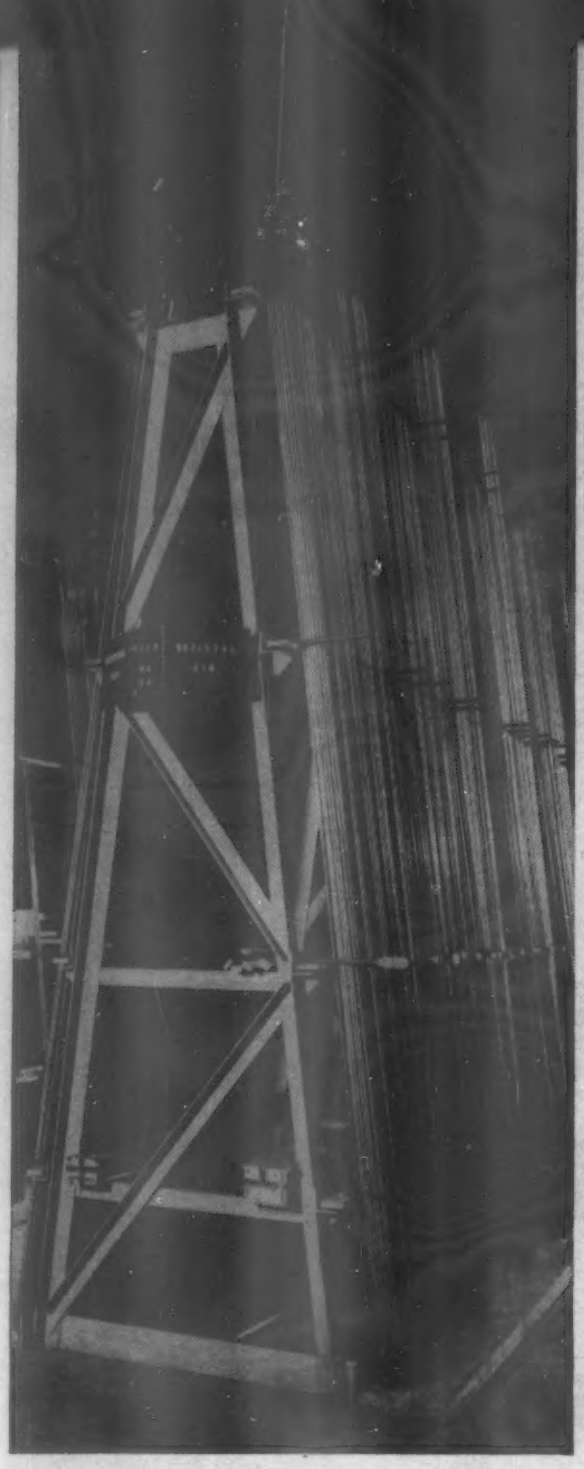
Facilities. Sanitary facilities include a large wash fountain in the 20x12-ft. locker room. A shower and other facilities are provided for the use of employees in a room adjoining the locker room.

Heating. Unit heaters are used in the warehouse areas to maintain a 55-deg. temperature. One low-pressure steam boiler, burning oil, furnishes heat for both warehouse and office. An engineering economy has been obtained through use of steam to heat warehouse areas, and later in conversion to hot water for office heat. This was the solution to the problem of maintaining two different temperatures in two parts of the building from the same heating source.

Offices. A 110x37-ft. two-story office building adjoining the warehouse has a 25x16-ft. lunch room on the second floor. A kitchen for employees, complete with range, refrigerator, sink and cabinets, adjoins the lunch room.

Ceilings are unpainted acoustical tile; walls are plaster, painted dusty rose, over building block; trim and sash are gray.

Offices are heated by hot-water type convectors. Lighting is pro-



VERTICAL STACKING cuts handling time required to take bar of steel out of storage from 4 to 1½ minutes

vided by industrial fluorescent units yielding 35 foot-candles. Conditioned air is supplied in the office building.

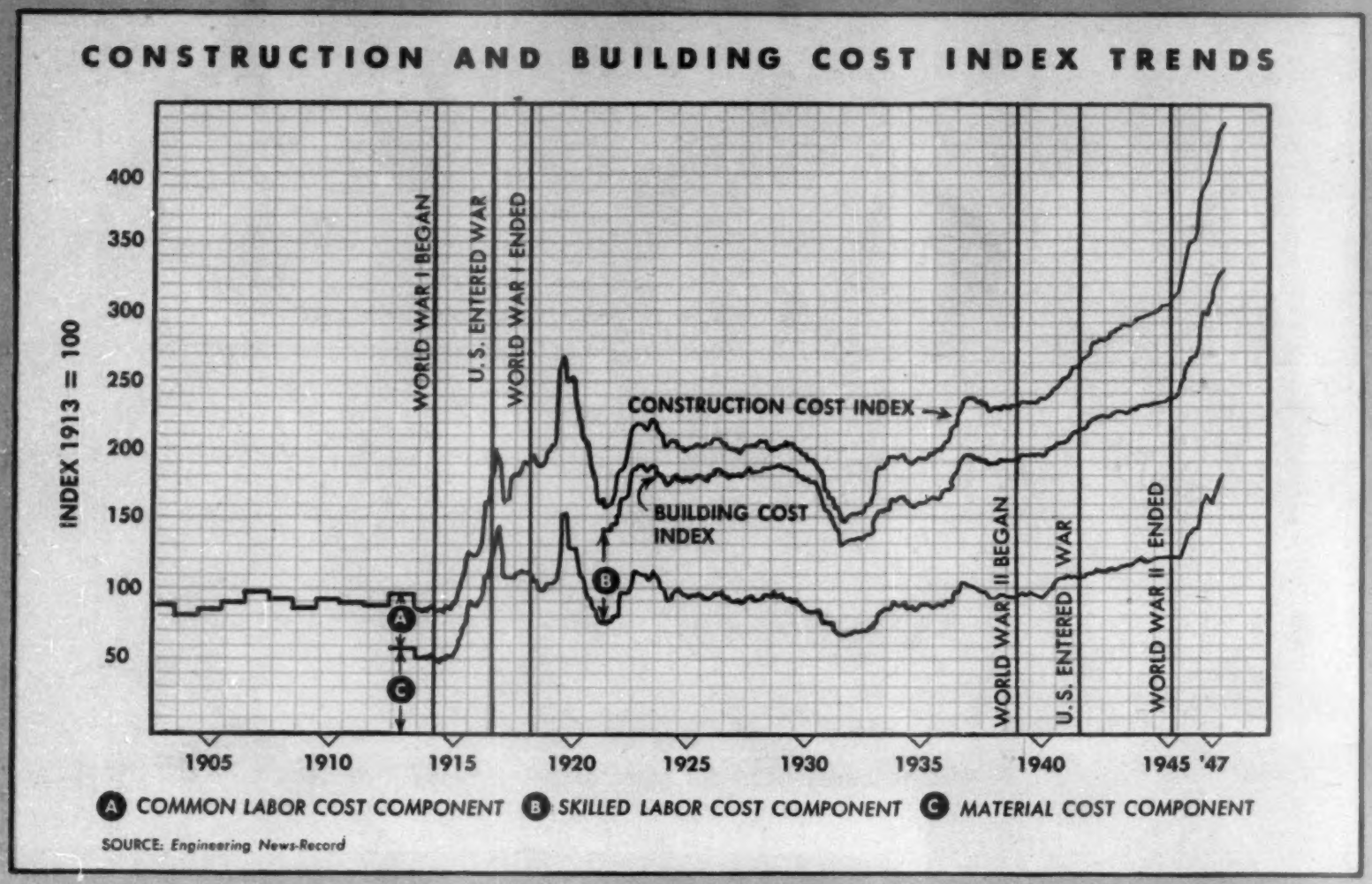
Men's and women's rooms are located on first and second floors. Decoration in the women's rooms is green on walls with white ceilings; in men's rooms, a light yellow color is used.

Grounds and access. There are grass plots and planting between sidewalk and building on both streets of the 2.3-acre corner property. A parking driveway on one side accommodates 25 cars. One truck entrance extends through warehouse to parking driveway. There is a triple truck entrance at the front of the building.

BEAUTIFUL IN ITS SIMPLICITY is this well-protected office entrance. Continuous band of windows provides good daylighting. Lunchroom for employees on second floor

DOWNSTAIRS RECEPTION LOBBY has modern touch with its functional use of glass block, its graceful hand rail of stainless steel, its lighting set flush with ceiling

LARGE WINDOW AREAS in office walls assure maximum daylighting. It is supplemented by fluorescent fixtures. Acoustical ceiling reduces noise. Asphalt tile floor



BUILDING MATERIALS

● Indications are that most building materials will be in better supply this year than in 1947. Shortages may develop in some items. For example, lumber, steel, and cast-iron pipe—three of the most important items in construction—seem likely to give some trouble. Also, to meet presently expected demands, the production of cement, gypsum products, and some other materials probably will have to exceed the 1947 output. On the whole, however, the building material stocks picture is definitely brighter than it was a year ago.

Despite the better supply situation, prices of many materials continue to climb. Bureau of Labor Statistics index for the wholesale prices of building materials, taking 1939 as 100, reached 211 in December, 1947. This December figure was 1.9 per cent higher than the November figure, and 21 per cent above the December, 1946, index.

Lumber showed the largest advance in price. In December, 1947, it was up 2.6 per cent from November, and 33.5 per cent above December, 1946. Structural steel was 19.1 per cent higher in December, 1947, than in December, 1946.

In December, 1947, brick and tile were up 14.5 per cent over the December, 1946, figure. Cement was up 13.8 per cent; plumbing and heating equipment, 18.5 per cent.

How long this upward trend will continue, and how far it will go, cannot be foretold.

Costs Are Higher

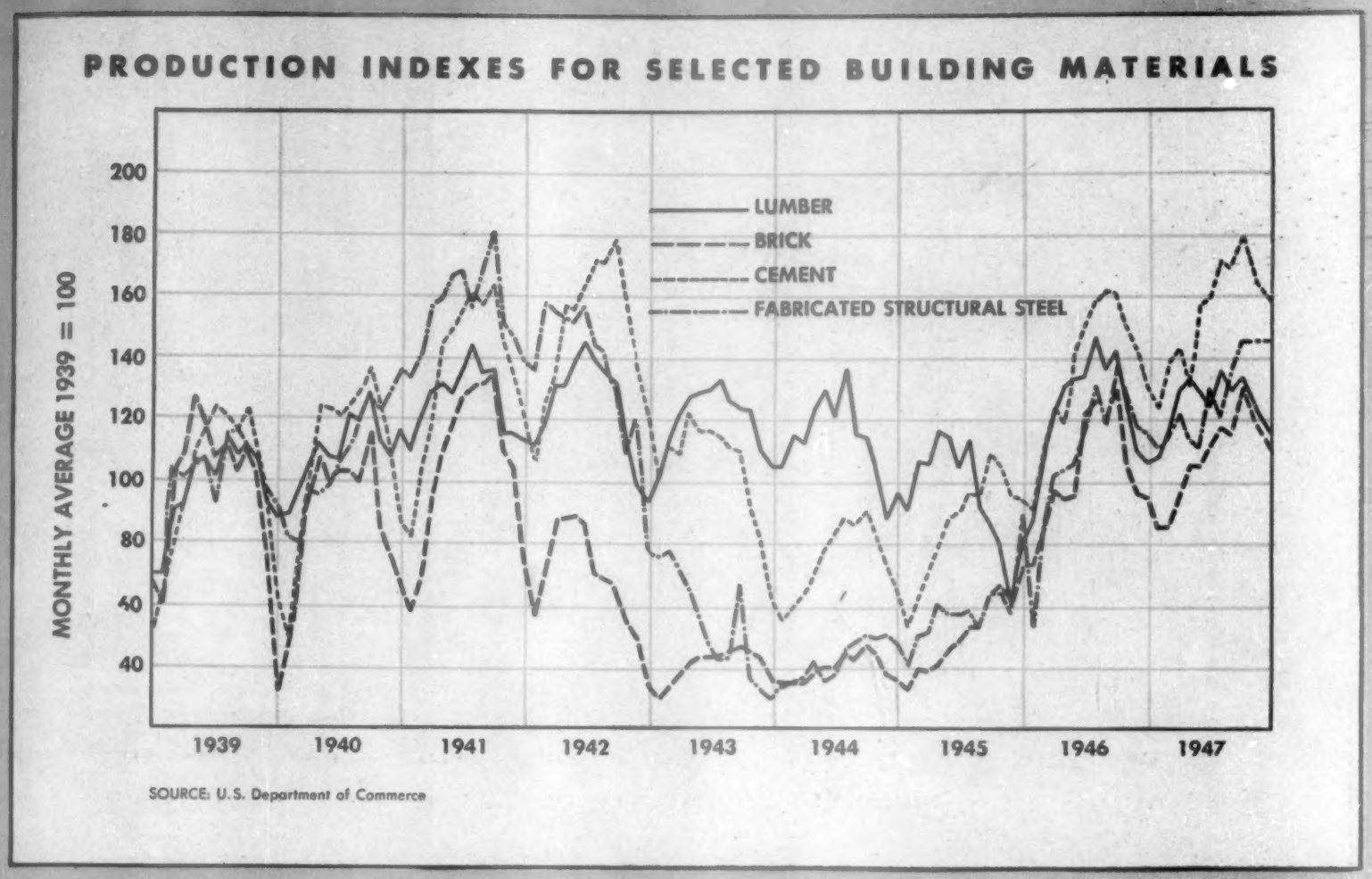
During 1947, construction costs in general increased about 18 per cent. At the end of the year, the Department of Commerce composite index was 206.5, more than twice the 1939 figure.

Taking 1939 production as 100, the production index for 20 selected construction materials reached 139.6 for 1947. This represents an increase of 11.6 per cent over the 1946 output, and is 4.2 per cent higher than the all-time peak in 1925.

Many of the materials included in this over-all index set new production records. Cement, for instance, established a new high; 186.5 million barrels were produced in 1947, 2 per cent above the previous all-time high of 182.8 million barrels in 1942.

Another new record was achieved by the production of structural clay tile, with 1.3 million tons. This exceeded 1946 production, the previous all-time high, by 13 thousand tons. Production of brick and vitrified sewer pipe was the highest since 1940 and 1929, respectively, but still below the record year of 1925.

Lumber showed the highest output since 1929, 36.6 billion board feet, which was 5 per cent above the



OUTLOOK FOR 1948

1946 output of 34.9 billion board feet. Soft plywood totaled 1.7 billion square feet, the highest since 1942, and 18 per cent more than 1946.

Production of gypsum board and lath was 3770 million square feet in 1947, as compared with 3146 million square feet in 1946. Production of gypsum products for the first month of 1948 suggests an optimistic outlook for the coming year; 372 million square feet were produced in January, 1948, which was 5 per cent more than December, 1947.

The outlook for fabricated structural steel is still very tight. Shipments for 1947 amounted to 1,915,144 tons, 23 per cent above 1946, and 31 per cent over the average pre-war years. However, tonnage available for fabrication within the first 4 months of 1948 totals 671,091 tons, almost twice the amount available during the same period in the average pre-war year.

Even with the increased physical production, the demand is so heavy that the shortage will probably continue for some time. One of the leading companies manufacturing reinforcing bars, for example, reported early in January, 1948, that its entire output through the month of August, 1948, had already been contracted for.

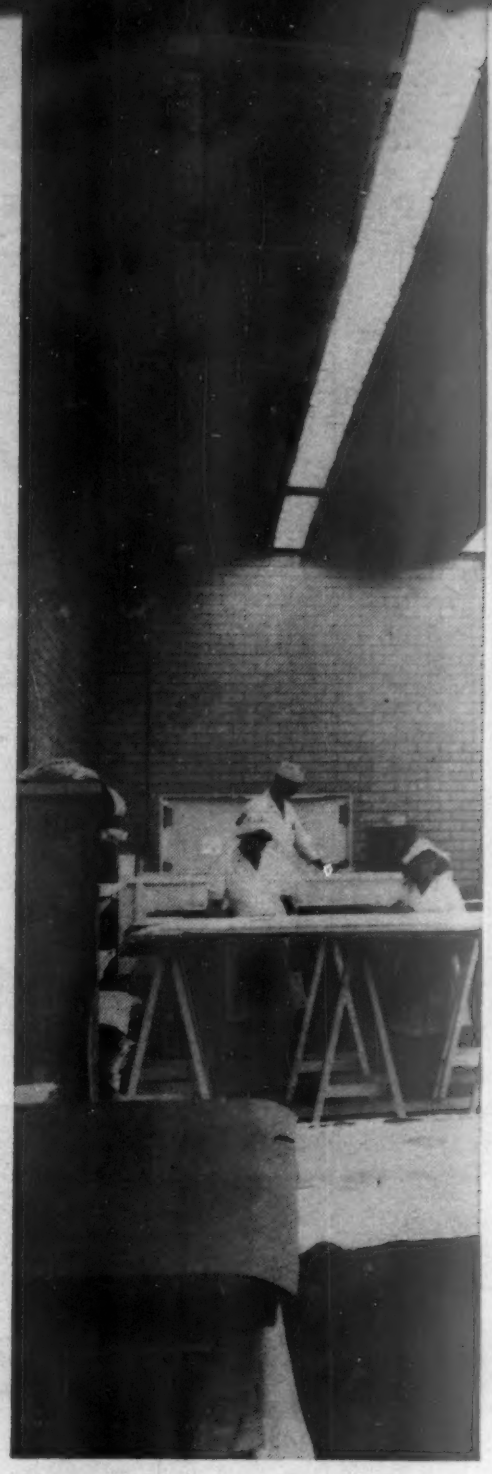
More Building Forecast

These reports seem to indicate an over-all lessening of pressure. How the supply situation will actually shape up, depends largely on the amount of new construction activity. Present estimates from various sources, reported in *Engineering News-Record,* forecast increases over 1947 construction ranging from 5 to 25 per cent in dollar volume, averaging about 14 per cent Unfavorable economic conditions would probably limit the increase.

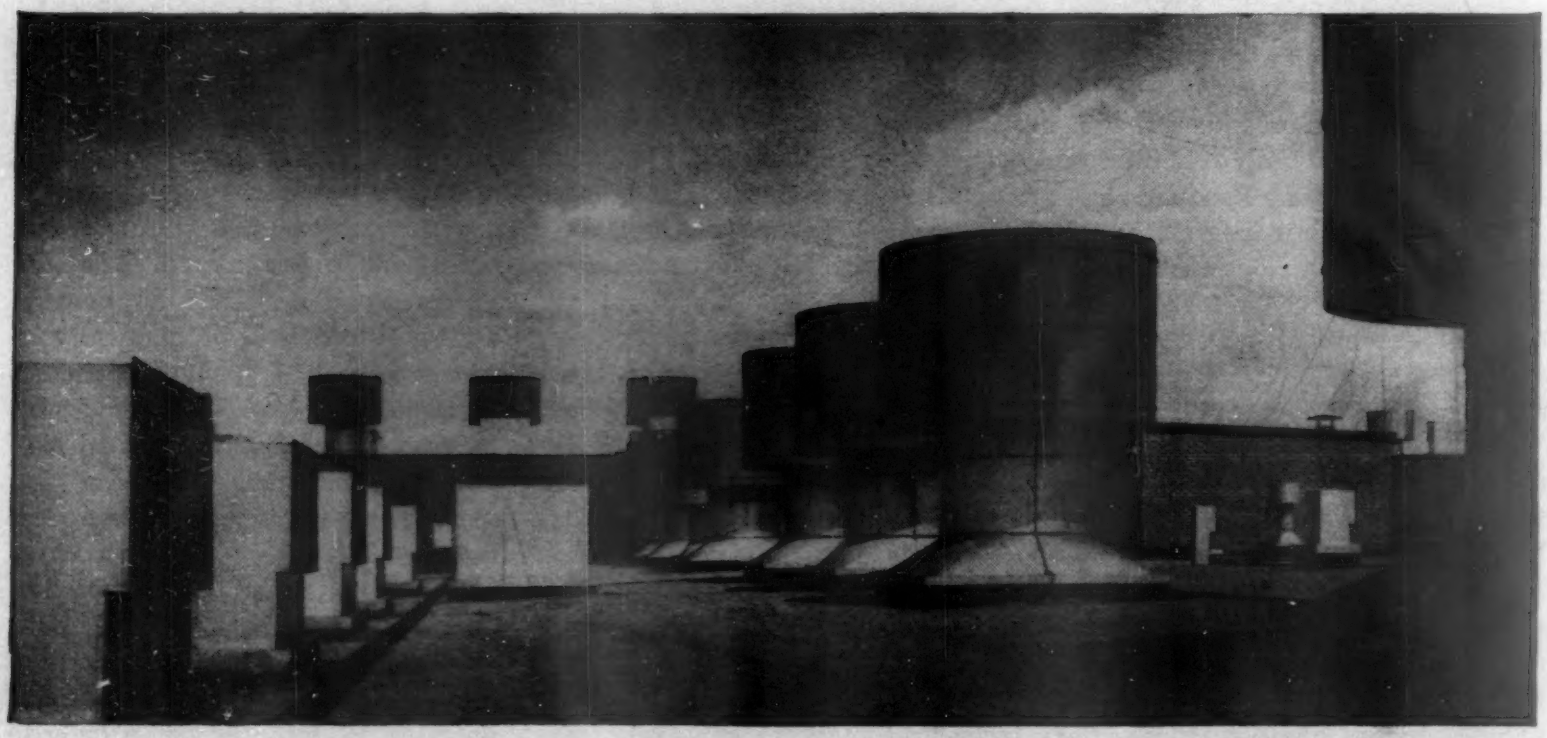
Another factor that will influence the situation is the fact that if serious shortages should develop in some of the major building materials, substitutions will be the natural result. This situation, in turn, could easily create a shortage in one or more materials that are now in fair or good supply. For instance, in order to meet the overall estimated demands for cement during 1948, it will be necessary to increase the 1947 production record substantially. And if it should be necessary to substitute cement for other construction materials, the situation will probably become very tight.

However, with production increasing all along the line, with increased plant facilities becoming available in many of the major industries, 1948 should see a definite improvement in the building material supply picture.

ENTRANCE to General Electric Company's laminated plastics plant at Coshocton, Ohio, is set off by limestone trim and stainless steel in simple, functional decoration



CONTROLLED CONDITIONS are paramount in department where materials are



STEEL DECK roof with 1-in. bonded tar and gravel topping is peppered with supply and exhaust fans. Intakes for unit ventilators, at left, are set in trusses. They are equipped with steam coils for heating air during winter months

inspected and assembled. Clear, glazed tile faces insulated walls. Electromatic filters remove all dust from atmosphere. Uniform lighting is assured by eliminating daylight; continuous fluorescent units give 48 foot-candles of light at work level

GENERAL ELECTRIC COMPANY

NEW PLANT AT COSHOCTON, OHIO

● Build the plant around the product. Design it to provide a setting for high production efficiency, low maintenance expense, and a maximum of employee comfort and convenience. General Electric Company tossed that challenge to The Austin Company engineers.

The new laminated plastics plant at Coshocton, Ohio, was the answer. Over 300,000 square feet of floor space were provided in this beautiful four-building plant for meeting the exacting requirements of complex and closely controlled processes inherent in laminated plastics manufacture. Everything from gears and bearings to insulators and refrigerator door panels is made here.

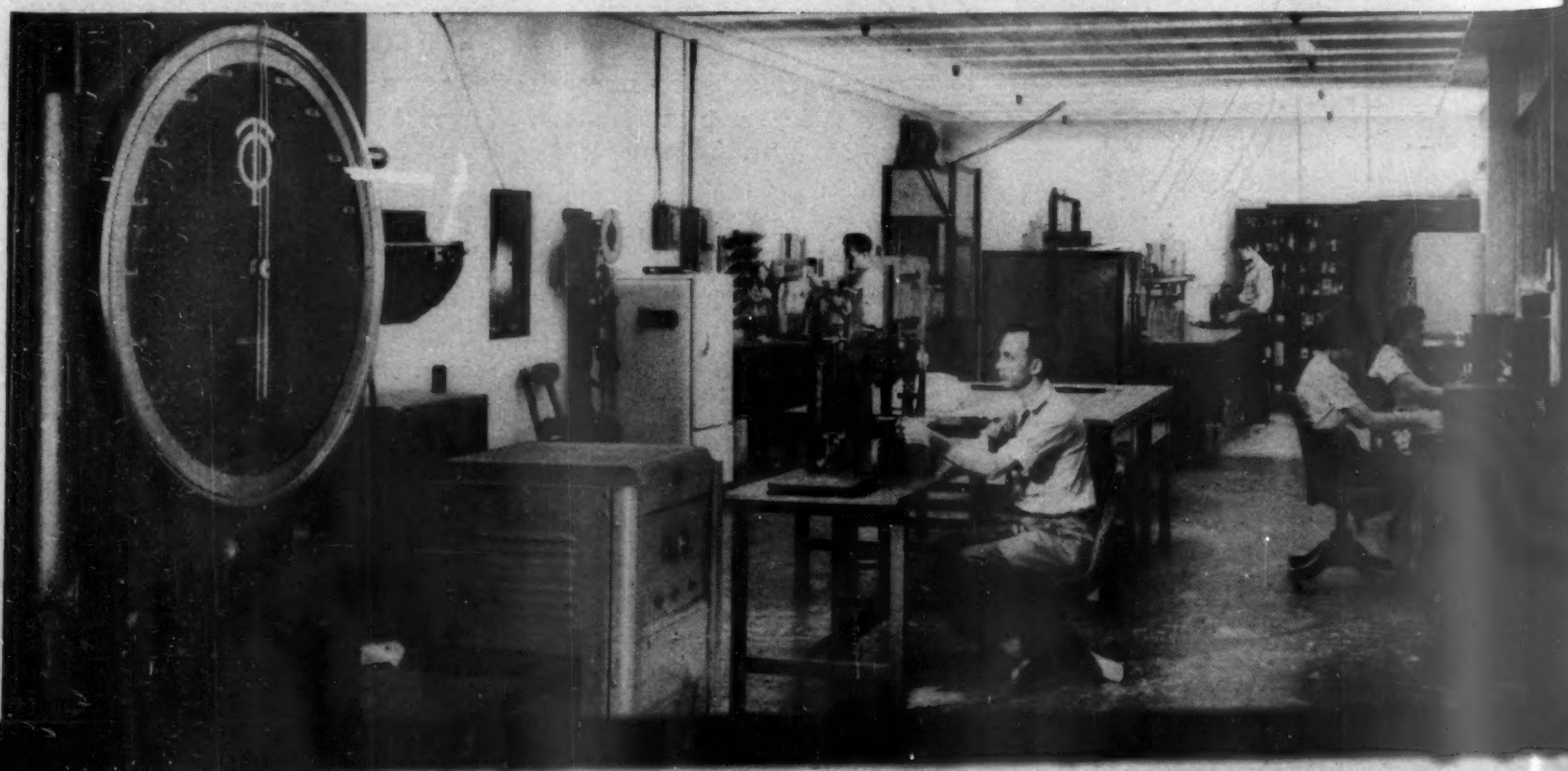
Engineer and Builder: The Austin Company, Cleveland

Main manufacturing plant. This building is 523x435 feet. H-section trusses, shop and field welded, have been used throughout a framework designed to permit maximum flexibility in the overhead installation of handling systems and building equipment. The use of 51-ft. trusses

WIDE COLUMN SPACING has simplified equipment layout in general manufacturing area. Illumination of better than 40 foot-candles at working level is maintained by two-lamp industrial fluorescent units, mounted 20 feet from floor

CRANEWAY BAY houses huge presses working around clock. Two-lamp fixtures, 34 feet above floor, mounted on 8½-ft. centers, provide 45-plus foot-candles. Reinforced concrete press foundations extend as much as 17 feet below floor level

LABORATORY is located in two-story, air conditioned office building. Glass fiber boards support continuous fluorescent troffer units, form suspended acoustic ceiling. Floor is asphalt tile. Movable steel partitions facilitate rearrangements



in combination with 41-ft. jack trusses throughout all portions of the building has made it possible to accommodate all production departments in the integrated straight-line layout, with a minimum of column interference. Column spacing is 41x51 feet. Clearance is approximately 34 feet in the high bay, and 20 feet in the low bay.

Incoming materials are received over large, depressed truck docks and a 205-ft. covered railroad siding. The siding extends through several controlled conditions departments to a high craneway bay where most of the heavy laminating presses are in operation. A 20-ton welded traveling crane operates in the high bay where an area of 51x330 feet is devoted to board pressing, build-up, and the molding of refrigerator doors. Here, hydraulic presses have been installed on isolated reinforced concrete footings, some with pits extending 17 feet below floor level.

Clear glazed tile, installed from floor to ceiling in these departments, provides the entire working area with soft, reflected light.

Clearance of 20 feet has been maintained below the trusses in the rest of the plant. Glazed tile has been used in the lower wall areas with acoustic cinder block above.

Temperature and humidity control. Air conditioning and special wall construction have been employed to maintain the close control of temperature and humidity required in the functional storage and build-up departments, prepared material storage, and treated-material roll storage. Outside walls have 4 inches of common brick on the outside, with 2 inches of glass foam insulation backed up by 4 inches of hollow tile and 4 inches of glazed tile, which is carried to the suspended ceilings in these departments. Atmospheric conditions are maintained at 70-deg. dry bulb and 35 per cent relative humidity by means of three special air conditioning systems, whose equipment is located on suspended mezzanine platforms convenient to the areas served.

Floors are 5-in. monolithic concrete with wire mesh reinforcement. The roof is constructed of steel deck

OFFICE AREA is well lighted—65 foot-candles at all times. Windows have operable sash, venetian blinds. Partition at right is of movable steel. Walls are painted restful green. Recessed fixtures are suspended in acoustical ceiling

POWER PLANT has main substation attached. Two boilers have been installed, and space is provided for third. Underground oil storage tanks hold 180,000 gallons. Air compressors and hydraulic pumps are in this 100x120-ft. structure

MAINTENANCE DEPARTMENT headquarters occupies space in power house. Boiler feed water pumps (right center) are located beneath huge feed water tank. Boiler feed water is conditioned in two tall cylinders at left. Finish is clear glazed tile

with insulation 1 inch thick and a built-up seal.

Power distribution and lighting. Power distribution facilities have been concentrated overhead, largely in trusses, where 3500 feet of interlocked armor cable, equally divided between 5-kv. and 600-volt sizes, has been suspended from the top chord by pipe brackets.

Power is supplied to two main substation transformers of 5000-kva. capacity at 34,500 volts and reduced to 4160 volts. Four unit substations of 1000 kva. are located in the main plant, and two of 750 kva. serve the boiler house and varnish building. These deliver 480-volt, 3-phase power to an overhead bus system comprising nearly half a mile of plug-in and feeder lines, ranging from 600- to 1000-amp. capacity. All the smaller transformers are on special mezzanines suspended from trusses.

Light is supplied by industrial-type troffer fixtures in continuous and semi-continuous lines, giving 45 foot-candles of illumination at work level. Fixtures in the high bay are mounted 34 feet high on 8½-ft. centers, whereas those in the general plant area are mounted in semi-continuous runs 20 feet high on 10¼-ft. centers.

All steam, water, air, gas, and 3000- and 500-lb. hydraulic lines are carried overhead in trusses.

Air conditioning and heating. A total of 188 tons of cooling required for several storage areas—totaling 17,200 square feet—is provided by mechanical refrigeration. Electromatic filters have been installed in these systems providing 6.7 air changes per hour.

Hundreds of supply and exhaust fans, the largest of which is 100 inches in diameter, 17 feet high, and handles more than 100,000 cubic feet of air per minute, extend through the insulated steel roof deck and furnish controlled ventilation to all other sections of the main manufacturing building.

Heat produced in certain molding and other operations is trapped in these areas and exhausted by drawing air from the heat-producing equipment at high velocity.

Winter heating is handled by introducing steam into the suspended unit ventilators which supply fresh air to work areas the year round.

Employee facilities. Locker rooms and restrooms for plant personnel have been concentrated, for the most part, on a 25-ft. mezzanine extending through the mid-section of the plant for a distance of 420 feet. This mezzanine also accommodates certain equipment rooms. The area directly below the mezzanine is available in part for use as an employees' cafeteria. It seats 150 persons. Adjoining the cafeteria is a fully equipped dispensary.

Roads and parking space. All service roads and a 400x300-ft. parking area on the south side of the plant have crushed stone base with asphalt topping.

Varnish building. The second largest manufacturing building is the varnish building. It measures 130x50 feet and has a 75x50-ft. wing. It is structural steel with concrete walls in the partial basement. Column spacing is 30x20 feet; clearance in the basement is 9½ feet; on the floor above, 22 feet. Steel grating serves as a floor over the basement. Sash are steel, partitions are glazed tile. Walls are painted cream with a 5-ft. dark green dado.

Explosion-proof lighting fixtures and power distribution equipment have been installed throughout the isolated varnish plant which is located at a safe distance from the general manufacturing layout.

Chemicals for use in various urea and phenolic resin compounds are mixed in the varnish building and piped underground to the manufacturing building through a tunnel.

All steam, water, air, and varnish lines are located in the ceiling of the basement area.

An open loading dock is located on the south side of the building to handle railroad cars and trucks. A ramp from the basement area to grade provides for escape.

Boiler house. A single-story, welded-steel boiler house measures 122x103 feet with 20x60-ft. column spacing and a 30-ft. clearance.

Two integrated, oil-fired, furnace-type boilers, each rated at 870 horsepower, and producing 45,000 pounds of steam per hour, have been installed. Sufficient space has been allowed for the installation of a third boiler unit. It is estimated that approximately 60 per cent of the steam generated in the plant will be used for process.

Oil storage capacity of 180,000 gallons has been provided in underground tanks adjacent to the boiler house, where a number of hydraulic pumps, serving 500- and 3000-lb. hydraulic pressure systems for the operation of laminating and forming presses, have been located.

The roof is pre-cast concrete tile with 1-in. insulation and a built-up seal. Color of walls is the same as in the varnish building.

Current is carried in armored cables overhead in trusses. There is a railroad siding on the east side for unloading fuel oil.

Office building. The 45x225-ft. office building consists of two stories and a basement. Its total area is 25,500 square feet. Column spacing is 18½x20½ feet. Clearances to lowest chord are 11 feet in basement, 13 feet on the first floor, and 14 feet on the second floor. Actual ceiling height is 10⅓ feet.

The two upper floors are air conditioned. The building has been equipped throughout with continuous, open-fluorescent troffer lighting units, mounted at a height of 10 feet, 3 feet apart, to provide 60 foot-candles of illumination. These units are flush with hairspun glass fiber boards used in the suspended acoustic ceiling. Floors are finished with asphalt tile.

Ninety tons of refrigeration are used in cooling the 18,450-sq.-ft. office area, where four air changes per hour are provided. Toilet rooms have mechanical exhaust systems. Movable steel partitions have been used throughout this building, whose second floor accommodates the offices of the plant manager and engineer; sales, order and accounting departments; and drafting room. The engineering department and laboratory occupy one-half of the first floor, and production planning, personnel, and plant superintendent share the other. Projected steel sash are used throughout. Electrical distribution, 110 volts, is in the floor.

SIMPLE FUNCTIONAL DESIGN characterizes Mengel plant. Office in foreground. All-weather loading dock for four trucks at left. Two-story laboratory section (right) contains large lounge. Two monitors provide light for production areas

THE MENGEL COMPANY

NEW PLANT AT FULTON, N. Y.

● Two prime considerations led to the construction of The Mengel Company's new Fulton, N. Y., plant.

1. Desire to serve the industrial area of western New York better.

2. To provide new facilities that would embody straight-line production of corrugated boxes and result in the maximum operating efficiency.

Owner and engineer cooperated in site surveys, equipment layouts, cost investigations, and structural studies to satisfy these additional necessary conditions:

1. Accessibility by railroad and highway.

2. Fully enclosed shipping operations necessary because of severe winters and nature of the company's product.

3. Layout adaptable to installation of new, improved machinery.

4. Provision for possible relocation of production equipment and rearrangement of operations.

5. Future expansion of manufacturing area.

6. Full use of materials handling equipment.

Manufacturing areas, offices and locker rooms, and boiler room are actually contained in one building, but will be described separately. Total building size is 500x150 feet, on a 13-acre plot.

Factory area. The manufacturing and storage areas measure 420x150 feet. Walls are constructed of brick with steel sash.

Roof framing was developed especially to meet the requirements of this plant. The 60- and 45-ft. roof beams were given intermediate support by diagonal steel tension members placed up in the monitors. This made possible the use of much longer roof spans than would ordinarily have been practical without resort to trusses. Considerable saving in steel tonnage was realized by taking full advantage of these diagonal hangers on beams and columns. Column spacing is 20x60 feet. Clearance to the lowest chord is 17¼ feet.

Special attention had to be given to floors because of severe wear from heavy paper-roll lift-trucks and loaded pallets. Earth fill under the concrete floor slab was carefully selected and firmly compacted to give uniform support to the heavy loads. Heavy mesh wire was used to reinforce the slab. A separate 1-

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Engineer and Builder: The H. K. Ferguson Company, Cleveland

TEMPORARY SOUTH WALL (in background) provides for ease of expansion later on. It is built of brick spandrel, high continuous sash, cement-asbestos-board above the sash. Moist atmospheric conditions inherent in process dictated dense pre-cast concrete roof;

in. finish of special mix and surface hardening was applied.

Light and heat. Natural plus artificial lighting was considered desirable. Two monitors run the length of the building with four lines of continuous sash 6¾ feet high. Fluorescent fixtures yield an intensity of 25 foot-candles at the 4-ft. level. Heat is provided by unit heaters; ventilation by fans in monitors.

Roofing. Because of moist conditions over the corrugating machine, considerable thought was given to the construction of the roof deck. Dense pre-cast concrete was used with the expectation of low maintenance cost and long-life service without appreciable added installation cost. The addition of 1-in. insulation board under the composition roofing contributes to sizable reductions in heating requirements and insures a more comfortable building in winter and summer.

Provision for expansion. Wide column spacing and constant clearance to roof were incorporated in the design. In addition, a temporary south wall was built of brick spandrel, high continuous sash, and cement - asbestos - board above the sash. This provides an economical wall with no sacrifice in appearance.

Transportation facilities. All receiving and shipping operations are entirely within the heated building. A railway spur enters from the east through a large track door and extends a distance of 360 feet along the north wall. This permits as many as six cars within the building.

The truck dock is a depressed area in the northwest part of the building, large enough for four 35-ft. trucks. The trucks are backed into the building through four over-

it is expected to insure long roof life at low maintenance cost

WINTERS ARE COLD in upstate New York. Two 300-hp. oil-fired boilers in 42x35-ft. boiler room adjacent to east end of main building supply plant with heat and process steam

AIR CONDITIONED OFFICE has venetian blinds, acoustical tile ceilings, fluorescent lighting, asphalt tile over concrete floor, air conditioning

head-type doors in the west wall. This all-weather treatment greatly increases the efficiency of loading and unloading operations.

Materials handling equipment. A monorail is installed over the corrugating machine for carrying paper rolls being processed. Rolls are brought up to the machine on floor conveyors. Board stock following the corrugator is stored and conveyed to the box-making machines on roll conveyors.

Power and utilities. Distribution of 440-volt power is by overhead bus ducts. Plant is equipped with a water softener.

Recreational facilities. A 20x30-ft. lounging room is equipped with chairs and reading material. Men who bring lunches eat there. Outside is a baseball diamond. A first aid room is available for emergency treatment. Parking space, 90x220 feet, is macadam-surfaced.

Administration section. This 2-story section measures 40x65 feet. Ceiling height is 8¾ feet. Asphalt tile covers the concrete floor; terrazzo is used in locker rooms. Partitions in offices are plastered; in lockers and toilets, glazed tile is used.

Air is conditioned to 72 degrees in winter and 77 degrees in summer, at 50 per cent relative humidity. Air diffusion is supplemented by wall-type radiation.

Ceilings of offices are treated with acoustical tile applied over plaster.

Boiler room. Supplying the plant with heat and process steam are two 300-hp. oil-fired boilers in a 42x35-ft. boiler room adjacent to the east end of the main building. Bulk storage of fuel is in a large outside tank.

LOCATED ON 10-ACRE SITE. PLANNED FOR FUTURE EXPANSION. NORTH WALL (NOT SHOWN) IS OF TEMPORARY CONSTRUCTION

THE BUSH MANUFACTURING COMPANY

NEW PLANT AT WEST HARTFORD, CONN.

● The war's end found the manufacturing facilities of the Bush Manufacturing Company housed in several plants which, because of the company's rapid increase in production, had become unsuitable for its operations. In order to increase efficiency in the manufacture of heating, air conditioning, and refrigerating equipment, and to provide adequately for future expansion, a new plant was constructed on the outskirts of Hartford to centralize all production activity within one single-story unit.

The site selected consists of 10 acres located between a main road line and a highway. Generous, hard-surfaced parking facilities are provided on the site.

Construction. Of the 110,000 square feet of floor area, some 100,000 square feet are open manufacturing floor. The steel frame construction has lally columns spaced every 20 feet. Two roof monitors, each 40 feet wide, extend almost the full length of the building. Exterior walls are brick, 5 feet high, with continuous windows around the perimeter. Aluminum sash are used throughout. Floor construction is concrete slab on grade, surface-hardened to prevent dusting. Certain sections are reinforced for heavy storage. Roof construction consists of ribbed steel decking on open bar joists with 2 inches of insulation and a built-up seal.

In accordance with modern safety practices, acetylene manufacture for production processes is located in a separate building; distribution lines run underground to the factory and then to localized production areas.

Room for expansion. It was anticipated that in the future an additional 40,000 square feet of floor area might be required. So it was proposed that, when necessary, the plant should be extended to the north to provide this area. Thus, the wall along the north side of the present structure is essentially a temporary one, consisting of wood frame and cement-asbestos-board sheeting.

Foundations along this wall were specially designed to accommodate additions.

Production lines. The layout of the production lines has been planned for maximum efficiency, and numerous overhead monorails were installed to facilitate flow. For power distribution, an overhead bus duct system is used. Thus flexibility is achieved for equipment changes and future connections.

Shipping and receiving. Both truck and rail serve the plant. A siding connects it to the main railroad line. An enclosed shipping platform with overhead doors along its full length furnishes excellent temporary storage facilities.

Color in the plant. Liberal use of color has been made to achieve maximum eye comfort and working efficiency. Executive offices are

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Architect: Charles DuBose, New York

Engineer and Contractor: F. H. McGraw & Company, Hartford

STRAIGHT LINES LEND CLASSIC TOUCH TO ENTRANCE. PARKING AT FAR RIGHT

painted soft tan. General offices are grayish green; ceilings are white. Within the factory, equipment is painted in harmonious colors. On the floor, color is used to designate traffic lanes, directional guides, danger zones, and aisles to be kept clear. Color is further used for identification of heating, plumbing, drainage, gas, air, acetylene, electric, and sprinkler lines. Overhead monorails and low headroom areas are similarly designated.

Lighting. Fluorescent 2- and 4-tube fixtures, set 9½ feet above the floor, give 20 foot-candles of light at working surfaces in the factory proper. Offices are lighted by diffusing-glass fastened fixtures set close to ceilings and designed to provide 30 foot-candles at desk height. Electric service is furnished by the local utility company and distributed from a transformer bank to power and light service panels.

Heating. A major factor in any plant located in New England, general heating at Bush is provided by two medium-pressure, oil-fired, steam boilers using heavy oil. These boilers also provide process steam for testing and cleaning. Factory areas are served by automatically controlled unit heaters; in the office section, automatic temperature controlled convectors supplied with hot water through a steam converter are used.

Air conditioning. The entire office section is air conditioned. Diffusing-type ceiling outlets are used, and in the executive offices these outlets are controlled individually by thermostats.

A sprinkler system arranged in four automatically controlled zones, and equipped with alarm valves, protects the plant. Sprinkler heads set flush with the acoustic ceilings are used in the offices.

Water distribution lines are copper tubing. Compressed air lines for 100-p.s.i. and 200-p.s.i. distribution connect reciprocating compressors to testing and cleaning equipment.

Cafeteria. Although the factory is not far from the city's business area, it has an employees' cafeteria of approximately 2500 square feet, which seats 200 persons at a service. The cafeteria may be reduced in size by a sliding partition for personnel activities, sales meetings, and so on. A mobile canteen serves employees during rest periods.

Employee facilities. Dispensary and first aid facilities are incorporated in the design of the plant. Large and centrally located locker, shower, and washrooms are provided for men and women.

Offices. An area of 8000 square feet is devoted to general and executive offices. Acoustic ceilings are suspended throughout this area; walls are plaster; floors are asphalt tile, except for the entrance lobby and toilet rooms which are, respectively, of terrazzo and ceramic tile.

General offices are located in an area of 150x400 feet. Seven individual offices, enclosed by counter-high partitions, are located here. Adjacent are three executive offices and a conference room enclosed with four partitions. Shop offices are placed right in the factory to provide maximum supervisory efficiency.

The well-appointed reception room reflects the good public relations policy of the company. Readily accessible to the visitor are maps, directories, and telephone facilities.

FLUORESCENT LIGHTING in production areas is supplemented by daylight through roof monitor. Floors are concrete slab, surface-hardened to prevent dusting

DISTINCTIVE GEORGIAN COLONIAL architecture graces main entrance. Administrative and factory operations, previously decentralized, are under one roof

LOBBY contains decorative landscape murals. Floors are rubber tile, furnishings

THE HALLICRAFTERS COMPANY

NEW PLANT AT CHICAGO

● The payoff for designing a plant around a process is both immediate and impressive. Witness The Hallicrafters Company new plant in Chicago. It was built when need for centralization of manufacturing facilities and reduction in excessive operating expense became urgent. Results:

1. Handling costs are down just about 35 per cent.

2. Less than half the former supervision is required.

3. Production efficiency is up nearly 25 per cent.

4. Product quality has been greatly improved.

5. Burden costs are down.

The plant is designed exclusively for the straight-line production of both technical and home radios. Its red brick exterior is of Georgian Colonial architecture. An impressive four-pillar portico graces the main entrance. The factory section is of single-story construction, with eight double-monitors to provide maximum natural light.

The building is 467x312 feet. Approximately 140,000 square feet of floor area houses the administrative and general offices; engineering and research departments; cafeteria; machine shop, stockrooms; assembly lines; phasing and testing departments; and the packing and shipping departments. Formerly, these various activities and facilities were scattered around in eight leased plants in the Chicago area.

Management specifications. Management established the following specifications before the plant was designed:

1. Develop the best possible production plan, then design the shell.

2. Make the exterior distinctive and eye-appealing.

3. Design the factory section to be practical and efficient.

4. Include modern facilities for employees.

5. Design footings and foundations to allow for two-story expansion at some future date.

6. Make all facilities, electrical, heating, etc., of sufficient capacity to permit twice the production planned at present.

7. Consolidate functions for minimum overhead expense.

The new plant meets these specifications, and more.

Production plan. The entire floor plan of the new plant is built around the straight-line, continuous-flow principle. Raw materials, such as tubes, condensers, and the 1001 parts required to manufacture radios, arrive at the truck receiving-well, located just right of the main entrance. This unloading dock is level with the standard height of truck floors. Rolling steel doors and large unit heaters make this an air-locked dock. Thus, truckers and handlers are able to

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Engineer: A. Epstein & Sons, Inc., Chicago

and paneling of bleached mahogany. Alcoves are used for displays and receptionist

UNIQUE IN DESIGN and well-appointed are these two executive offices. Sliding panels convert them at a moment's notice into one large conference room

work in complete comfort, even in coldest weather, and cold blasts of air are prevented from sweeping into the plant proper. A railroad siding accommodates three cars.

Inside the plant and adjacent to the receiving-well is the pre-test section where all parts are given either a spot or full inspection. From here, materials feed directly into the main stockroom located in the center of the plant. Periodically during the production day, materials are fed to six continuous assembly lines. These materials emerge from the assembly division completely assembled, tested, and packed ready for shipment. The separate shipping dock eliminates necessity for materials to backtrack to the receiving dock. Like the receiving dock, the shipping dock accommodates two trucks.

Lobby. A spacious 18x36-ft. lobby has hand-painted canvas murals around its circumference depicting countryside scenes. Flooring is decorative rubber tile. Bleached mahogany furnishings and paneling heighten the reception lobby's cheery atmosphere. Two alcoves are paneled with window-like frames, one for display of company products, the other for the receptionist and telephone switchboard.

Executive offices. Interesting design highlights the president's and executive vice-president's offices. They are adjacent and have a sliding panel between them which can be opened to make one large executive conference room. Complete conversion requires only a few minutes. Pinpoint ceiling lighting produces between 45 and 50 foot-candles of light at desk level. Offices are wood-paneled and have acoustically treated ceilings. Signal tables, located behind the desks, enable the occupant to control all lighting in the room, and a series of signal lights can be used to indicate what he wants or where he will be if he leaves the office. Building a separate conference room would have doubled the cost.

Communications. There are two independent sound systems in the plant, one for broadcast of musical programs throughout the plant in the middle of the morning and afternoon. Frequently, an important radio broadcast is relayed via

OFFICES ARE ROOMY and airy, with 40 foot-candles at work level. Floor ducts throughout area make telephone or electric outlet possible at any point

FLUORESCENT FIXTURES supply 90 foot-candles at work level. All service lines overhead. Two-pipe vacuum-return system with unit heaters. Fans for summer cooling (arrow) mounted 7 feet above floor. Eight double monitors for natural illumination

this system to the employees. The other system is operated from the main telephone switchboard and is used only for calling key individuals to the telephone, or to relay important messages to employees.

Structure. The structure has brick enclosing walls. Column spacing is 20x40 feet. Clearance from floor to lowest chord is 12 feet. The factory floor is 6-in. concrete on fill with reinforced wire mesh, and is treated to increase hardness and wear resistance.

Pre-cast concrete roof slabs, 18x48 inches, are of the free-floating type and are supported on steel purlins, girders, and columns.

The roof is well-insulated, having 1 inch of fiberboard insulation with built-up asphalt composition roofing on top. The entire roof is pitched to downspouts to permit slow drainage. Additional insulating value is obtained by an outside roof sprinkler system. Over 200 mist-spray nozzles, located in 15-ft. squares, are mounted atop the office, factory, and monitor roofs. These are turned on in summer from 6 a.m. to 6 p.m. Inside temperatures have been reduced between 12 and 15 degrees by this procedure.

Heating. All office areas have floor panel radiant heating, consisting of a series of hot water pipes buried in concrete. Rock wool insulation is used in walls, and there is a 14-in. granular fill above the ceilings. Flush-type ceiling ducts are used to circulate cool air in summer. This installation was made with an eye to future conversion to full air conditioning.

The factory section has a two-pipe vacuum return steam heating system with radiation consisting of unit heaters and conductors. Two low-pressure boilers are fired by oil burners with an underground storage tank. Oil can be delivered via tank car or by motor carrier. A gas-fired hot water heater is located in the boiler room to provide hot water during summer months. All controls are electrified, with blowers being turned on and off by clock. Thermostats control functioning of the unit heater system. The system is so planned that it is used to heat in winter and cool in summer.

Fireproof construction and ceiling sprinklers throughout the office and factory area enable the company to obtain an unusually low fire insurance rate. Two 30-hp. compressors located in the boiler room supply air for processes.

Lighting. Offices and drafting room have troffer fluorescent flush-ceiling-type fixtures with prismatic lenses. Light intensity measurements at work level indicate 40 foot-candles in the office and 60 foot-candles in the drafting room. All fixtures are non-glare, dust-proof, two 40-watt tube type.

Industrial fluorescent fixtures are

used in the manufacturing area. Fluorescent fixtures are mounted in a continuous line on each side of the assembly lines, close to the working plane, to give maximum light intensity of 90 foot-candles. Floodlights, located outside the plant, illuminate the portico after dark.

Electrical distribution. Electrical distribution was planned with an eye to the future by Hallicrafters' maintenance division. All transformers, circuits, and panels were planned and installed to take double the load required for present production. This will allow for expansion without costly changes.

The 4-wire, 3-phase distribution system (208/120 volts) is used for lighting. Three 800-amp. service switches are used with one standby for emergencies. An entirely separate system, 3-phase, 3-wire, 220-volt, distributes energy for motors and other requirements. Both systems are distributed laterally overhead via conduit and cable.

Office layout. Offices are grouped according to the flow of work. Around the perimeter of the general offices are located private offices. These are enclosed with routed-wood partitions with central clear panel glass sections to allow the occupant clear observation of office functions. Offices have asphalt tile flooring and acoustically treated ceilings to reduce noise. A complete underfloor duct system runs throughout these areas to provide outlets at any location for telephone and electrical connections.

Employee facilities. Central cloakrooms are adjacent to the employees' entrance. Each employee, upon entering the plant, must check outer garments. Also he must check them out before leaving the plant.

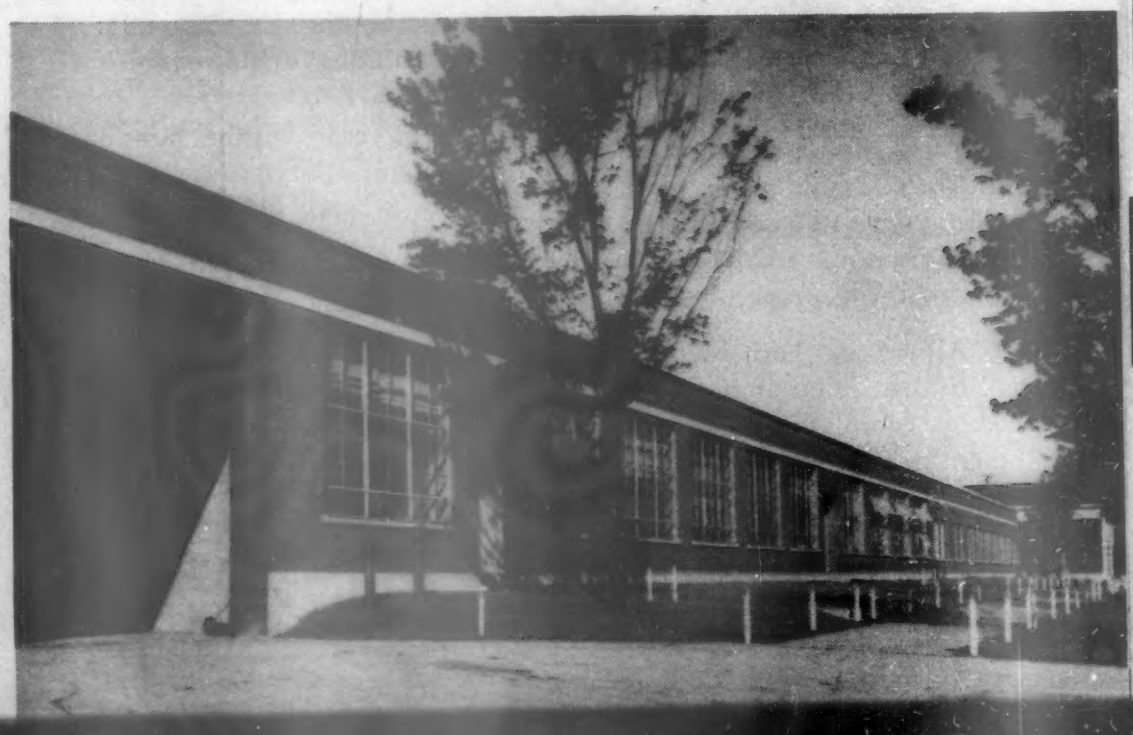
The spacious cafeteria is located for the convenience of both office and plant personnel. It was designed to accommodate about 500 people. Breakfast is served before shift time between 7:30 and 8 a.m.

Employee facilities have been provided on a liberal scale throughout the plant. The dispensary has necessary equipment for first aid and is located adjacent to office and factory areas.

CAFETERIA is close to both production and office areas. Accommodates about 500; employees can breakfast here before shift time each morning

ROOF SPRINKLER SYSTEM with over 200 mist-spray nozzles keeps plant 12 to 15 degrees cooler than outdoors on hot days. Monitor has continuous-light, operable steel sash

TRUCK ENTRANCES are protected by steel bumper columns. Spacious drive permits trucks to maneuver. Footings and foundations allow for construction of second story



FUNCTIONAL LINES characterize this new plant. It was designed to permit 100 per cent increase in capacity without building expansion or alteration. Single-story construction with two high-bay monitors and process tower. Light buff face brick on exterior walls. Top of walls finished with copper-covered eaves. Doors to truck loading dock at right. Railroad receiving platform at back of building

ECONOMICS LABORATORY, INC.

NEW PLANT AT LYNDHURST, N. J.

● Two divergent requirements had to be resolved in arriving at a suitable size and layout for the new Economics Laboratory plant at Lyndhurst, N. J., where detergents and germicides are manufactured:

1. The scheme had to permit meeting current sales demand with a minimum of equipment in the manufacturing process.

2. Allowance had to be made for future maximum production through complete mechanization of the entire process.

The final solution resulted in a minimum initial investment, which will permit a 100 per cent increase in production by installation of additional equipment. This is truly a small building capable of doing a big production job.

No increase in the size of the building or alteration will be necessary to achieve this production increase. General provisions of the plant include:

1. Exterior railroad siding and covered platform for the receipt of raw materials.

2. Floor storage of new materials in bags and drums, and paper container supplies.

3. Batch mixing equipment.

4. Storage bins for various formulated products.

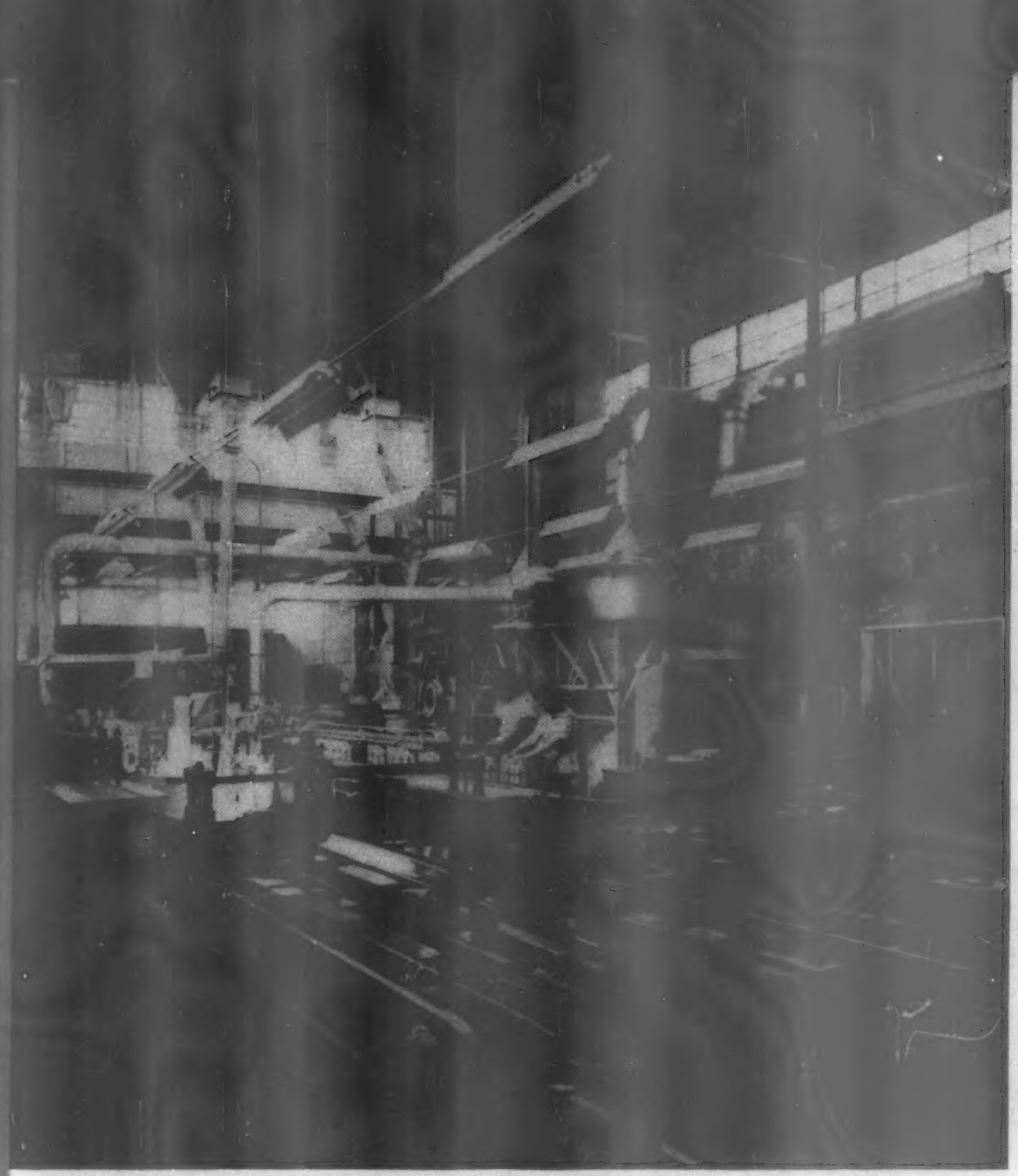
5. Packaging lines.

6. Adequate floor storage for finished products.

7. Interior truck dock from which products are shipped.

Engineer and Builder: Walter Kidde Construction, Inc., New York

Construction. The 44,600-sq.-ft. plant is located on a 6-acre landscaped plot. It is single-story with two high-bay monitors and a process tower. The structural system is



UNDERSIDE OF STEEL ROOF DECK and exposed surfaces of framing and windows are finished in aluminum paint. Daylighting from sidewall and monitor windows is supplemented by fluorescent lighting. Floors are concrete treated with metallic hardener

a typical skeleton frame of steel girders, beams, and columns, all supported on a spread foundation of reinforced concrete. Instead of usual channel and angle assembly for the fascia beams located between roof eaves and window heads, a system of angles and plates has been designed to give weather-tight construction. Column spacing is 20x40 feet; clearance is 16½ feet to main roof and 23 feet to monitor roof.

Walls. Masonry walls are of solid brick, 8 inches thick, having exterior faces surfaced with an attractive range of light buff brick. Tops of walls were terminated with copper-covered eaves rather than the traditional brick parapets. This construction effected an initial saving and eliminated possible leaks and disfiguring efflorescence. Exte rior faces of the process tower are sheathed with a combination of plain and corrugated asbestos cement boards. Partitions in the office areas are structural clay tile with hard, white gypsum plaster; in manufacturing areas, unscored structural clay tile.

Steel sash are used throughout. In the factory area they are pivoted with manually powered mechanical operators for the monitor ventilators. Glazing of windows was executed after completion of the finished painting. This reversal of the usual procedure was made possible by use of a mastic glazing compound which had been factory-colored to match the finished painting on the sash. With this method, expensive cutting in of painting at glass lines is eliminated. Costly maintenance is avoided by use of a glazing compound that remains plastic indefinitely without paint protection.

Roof. Roof decking is 20-gage pressed steel sheet, having ribs 1½ inches deep at 6-in. spacing. This steel decking is connected by fillet-welding at each lap of the longitudinal rib joints with tops of structural steel purlins. Also, these joints in the decking are stiffened by wedge-welding on the upper surfaces. Roof insulation is 1-in. fiberboard applied over a vapor seal of asphalt-saturated felt which was first cemented to the steel decking by hot asphalt. Insulation is covered with 20-year bonded built-up roofing, using coal-tar-saturated felt and coal-tar pitch surfaced with slag.

Floors. All floors throughout are reinforced concrete slabs on ground. Except in offices, they have been treated with metallic floor hardener and given a hard, steel-trowel finish. Office floors are finished with asphalt tile.

Throughout the factory interior all exposed surfaces of the steel roof decking, framing, and windows are painted with aluminum paint. This finish has allowed a more uniform distribution of daylight entering from high sidewall and monitor windows. Photograph of interior (left) was taken without use of any artificial illumination. Windows, doors, trim, etc., are coated with buff-colored lead and oil paint.

Heat. Space heating is provided by an oil-fired, low-pressure steam boiler connected to unit heaters in the factory, and cast-iron radiators in offices.

Light. Fluorescent lighting of 40 foot-candle intensity is installed for offices. The factory area is provided with fluorescent fixtures giving 30 foot-candle intensity. The entire building is provided with a wet-pipe sprinkler system.

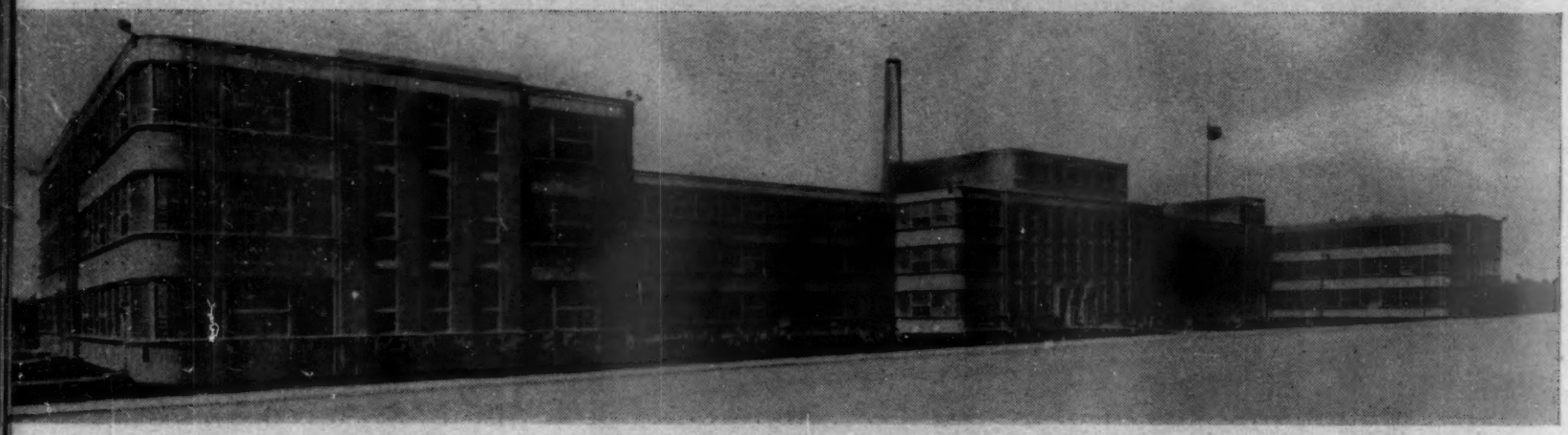
Electrical distribution. Cables in overhead conduit are used. Power voltage is 240; light, 120. Water and gas are piped in from city mains.

Sheet steel chutes are provided to allow gravity flow to packaging machines and bulk filling units.

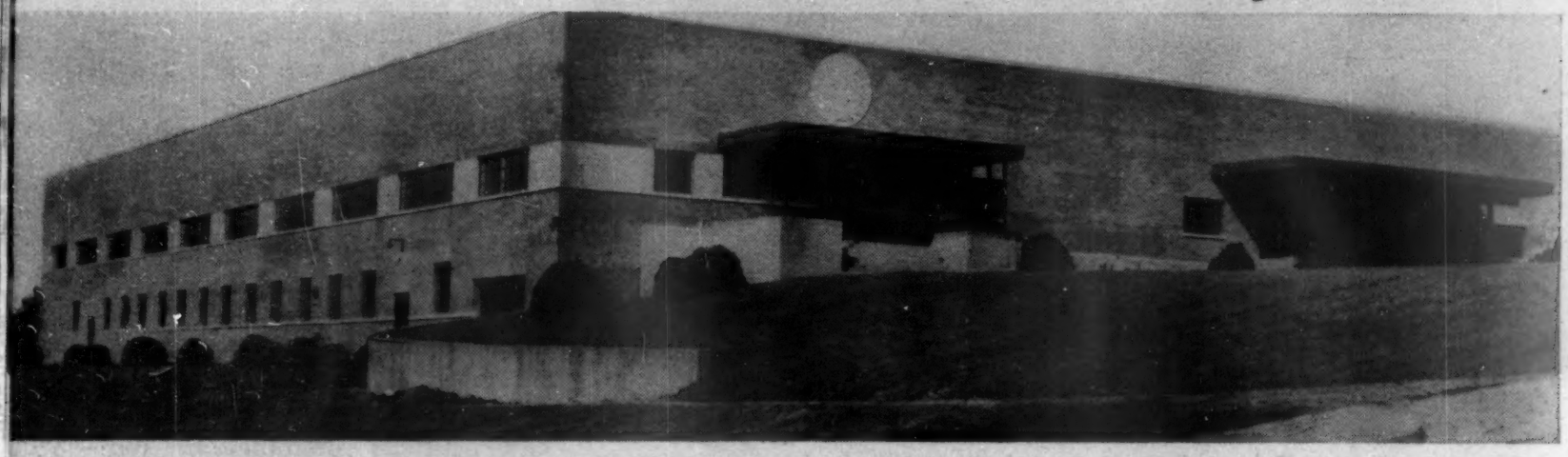
Showers are included in the sanitary facilities. Locker room is finished with cement plaster wainscot.

A chain link fence surrounds the area. The plant is served by a bituminous macadam pavement.

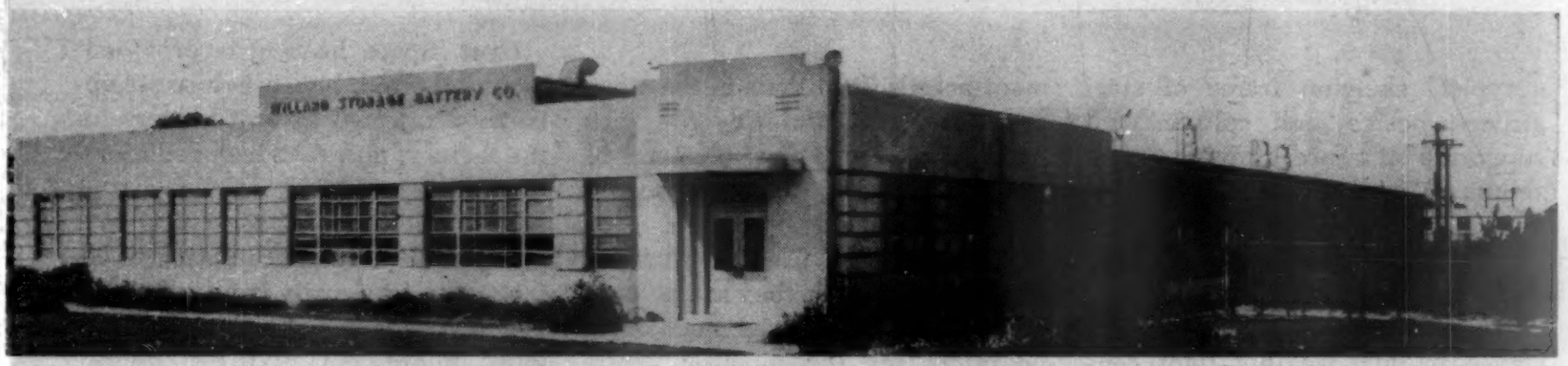
QUICK LOOKS AT EIGHT NEW PLANTS



BELL & HOWELL COMPANY, Chicago. Motion picture equipment. Three-story building. Reinforced concrete construction. Exterior walls are brick, glass block, concrete trim. Interior walls are tile block. Area, 227,566 square feet



BELDING-HEMINGWAY-CORTICELLI COMPANY, Morristown, Tenn. Nylon and rayon thread. Two-story building. Steel frame construction; 50x50-ft. column spacing, 12-in. brick walls, conditioned air, electric heat, fluorescent lighting



WILLARD STORAGE BATTERY COMPANY, Memphis. Electric storage batteries. One-story building. Concrete walls and floors, steel deck roof, fluorescent lighting. Interior painted in three shades of green. Covered loading facilities

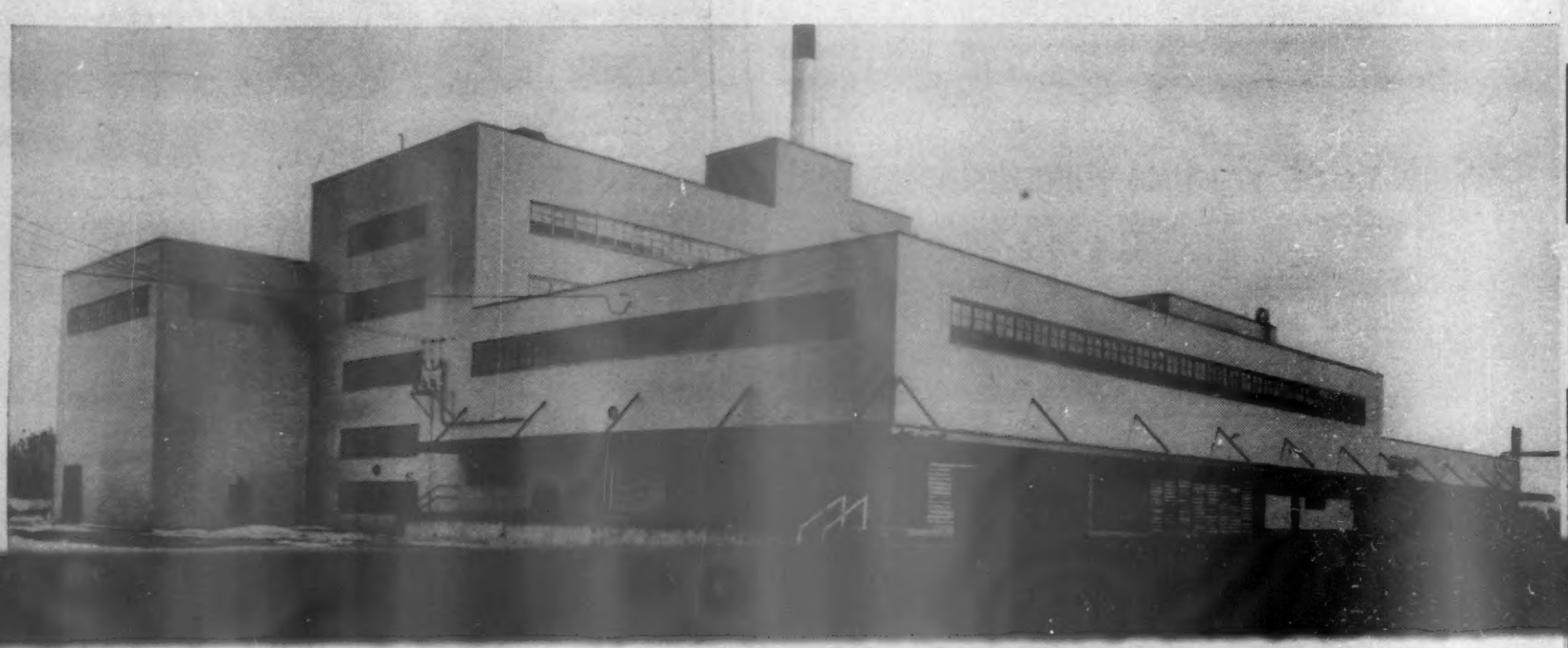
MONSANTO CHEMICAL COMPANY, Monsanto, Ill. Synthetic detergents. Steel, reinforced cement block, and brick construction with corrugated asbestos siding, pre-cast roof slabs. Area, 80,000 square feet. Multi-storied to suit process

THE STANDARD REGISTER COMPANY, Dayton. Business machines and forms. Two-story building, faced with tapestry brick. Concrete foundation, floors, roof slabs, and columns. Interior painted in colors

PACIFIC AIRMOTIVE CORPORATION, Burbank, Calif. Aviation overhaul and maintenance tools. Single-story. Welded steel frame, wood composition roof, concrete slab floor, monitor construction. Area, 12,000 square feet

MARATHON CORPORATION, Menasha, Wis. Paper boxes and cartons. Single-story and basement. Steel girders and columns, reinforced concrete and brick walls. Monitor roof. Area, 304,000 square feet. U-shaped layout

LIBBEY-OWENS-FORD GLASS COMPANY, Toledo. Coating resins. Five-story steel building. Concrete and brick walls, pre-cast concrete roof, reinforced concrete floors. Interior painted greenish-gray. Area, 88,000 square feet



PLAN MAINTENANCE— FOR BUILDINGS OLD AND NEW

It's now or else in building maintenance. . . Five war years meant substandard upkeep. Manpower and materials shortages throughout 1946 and 1947 dictated postponement in far too many industrial plants

But, by and large, manpower is not so tight today. Neither are materials. And industry has the money

Foresighted management will therefore give building upkeep the call for 1948. It will set up a program of preventive maintenance as suggested here—and it will use a checklist (like the one appended to this article) to make sure nothing that needs doing is left undone

WHETHER your plant is a generation old or still in the blueprint stage, *now* is the time to reduce *future* maintenance costs. Planned maintenance is the way to do it.

Too often, in periods of low income, necessary maintenance is deferred. That means accelerated deterioration, for greater total cost.

To a lesser extent, the same thing is happening today. In the drive for ever-greater production to meet pent-up demand, maintenance does not always get the attention it requires. The short labor supply and the consequent high cost of maintenance do not make immediate action attractive, either.

This, combined with five war years of substandard maintenance, means just one thing — *danger ahead!*

But there is a bright side to the picture. Industry's earnings are good. With few exceptions, the money is available to do the job required to cut *tomorrow's* maintenance costs.

Fundamentally, the problem is the same in the brand-new plant as in the old one. New materials and new construction techniques mean some differences in maintenance procedures. But trouble spots remain more or less constant.

However, there are a few important differences in the matter of today's approach to tomorrow's maintenance problems.

THE OLD PLANT

The main consideration here is to determine what needs to be done to bring the plant, maintenance-wise, completely up to top-flight condition—and then *do it!*

Start with an inch-by-inch survey of the entire physical property. The appended checklist contains some of the more important things to look for. However, do not limit the examination to these points. No job is too big to be out of the province of the survey report (even though the remedy is beyond the maintenance department). And no job is too small not to be a cause of potentially bigger trouble if it is left unheeded.

Make every reasonable attempt to ascertain the cause of every failure. This is of particular importance in three classes of plants:

Very old buildings. The older the building, the more necessary it becomes not only to repair the failure, *but also to remove the cause.* Lacking this, the same or another failure is almost certain to crop up. While this is also true in a newer plant, the time element involved will vary inversely with the age, and the frequency of the repairs may soon make the cost prohibitive. Although the factor of age complicates the problem substantially, the type of "materials and loading specification" survey outlined in the following section for use in war-built plants may also be of considerable value in old buildings.

War-built plants. Severe restrictions on building materials were imposed during the war. As a result, many building elements have a relatively short life expectancy. Timber, for example, was frequently green, seldom properly treated. Steel mesh for concrete walls and floors was largely unavailable. Piping and electrical wiring were substandard (from any long-term point of view). And, perhaps most important, safety factors were cut to the bone all along the line.

The philosophy was that the plants were to serve only during the war, hence it was not necessary to build long life into them, except where this was structurally necessary because of the nature of the process or machinery. Consequently, many of these plants are still structurally sound and will remain so for many years to come. But just about now, the substandard service and non-structural elements are beginning to show their "true colors."

Close inspection will disclose many of these war weaknesses. Many others, however, are subsurface (or involve loading limits) and will not be evident to the naked eye. For this reason, it is important that the inspector or a competent maintenance engineer (if the inspector is not technically trained) obtain a set of blueprints, together with material and loading specifications.

Do not limit the examination to checking those elements where physical failures have occurred—although those spots warrant priority

(*Continued on page* B-84)

SHERWIN-WILLIAMS

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How would you like to use a mill white of such superior quality that it *covers most surfaces in one coat*... is *readily cleaned* either *with a dry cloth or soap and water*... is one of the *quickest-drying* mill whites ever developed!

Just make sure your plant is painted with Sherwin-Williams Save-Lite White—that's all!

Sherwin-Williams Save-Lite White saves you money *because* of these remarkable features. *High Coverage* means less cost for materials and labor. *Washability* means you don't spend money on frequent repainting. *Quick Drying* means you can put the whole plant in production *the day after* the paint is applied!

And that's not all. We have developed Special Formula Save-Lite Whites that are amazingly resistant to the effects of *heat, fumes, moisture! Write now for full details.*

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can do wonders for product quality, output, employee morale! Sherwin-Williams color specialists *selected* each color and color combination in the Kem Color Harmony line to help you combat fatigue, eyestrain, accidents, labor turnover... to cut down rejects!

Start now to make the fullest use of S-W Kem Color Harmony—color engineered for industry. Start now to bring increased output, improved working conditions, lower costs *to your plant!* Write The Sherwin-Williams Co., Industrial Division, Cleveland 1, Ohio. (Export Division, Newark, N. J.)

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When You See One of These Every 50 feet - that's *Dependable Protection!*

NEXT to having no adequate fire-fighting equipment is *not having enough.* A small fire can leap to destructive size during the crucial moments it takes to bring an extinguisher from one department or room or floor to another. Approved protective practice calls for no point to be farther than 50 UNOBSTRUCTED feet from a dependable extinguisher. Now is the time to double check your fire-fighting equipment.

There is a size and type of Buffalo *better-built* Fire Extinguisher exactly suited to ever class of fire hazard. There probably is a thoroughly trained Buffalo representative in your locality who will be glad to assist you in checking your fire-fighting equipment. If he is not listed in your classified telephone directory, write us direct.

BUFFALO FIRE APPLIANCE
CORPORATION
DAYTON 1, OHIO

(Continued from page B-82)

attention. The first step is a physical inspection of all substandard materials used in the plant. Where a combination of substandard material and low safety factor (or actual overloading) is encountered, immediate replacement or lessening of the load is probably in order.

As the inspection proceeds, make an exhaustive list of all substandard materials, and their present condition. After each item on such a list, the inspector should enter his appraisal of the probable number of additional years of satisfactory service, and any special notes regarding the need for abnormally frequent inspections. Such a list will prove invaluable in simplifying the future job of the maintenance crews and in preventing the development of serious trouble.

The second step is to check all points of known overload or low-safety factor, regardless of the quality of the material used. Natural deterioration of even the best materials, caused by use and the elements, may have produced an unsafe condition by this time. A list similar to the one described above should also be compiled for the check. If the necessary technical competence for a survey of this nature is not available among the regular personnel, management should not hesitate to obtain the services of an outside consultant.

Reconverted plants. This includes not only war-built plants and those recently engaged in war production, but *any* plant in which a major change in process or relocation of manufacturing facilities has taken place. Such changes subject the entire physical plant to altered conditions—not always conditions the structure was built to withstand. Hence the additional need for remedying the cause as well as the effect. Here, again, blueprints and original specifications are indispensable to the maintenance engineer.

Make the needed repairs now. *Today.* While the money is available. By bringing the plant into top-flight condition it will be possible to institute the practice of so-called preventive maintenance, thereby saving a substantial part of future potential costs. However, introduced into a below-par plant, so-called preventive maintenance is just "so-called," and nothing more.

There are three possible reasons why it might be desirable, from an over-all point of view, to defer some

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Main "dispatching" station for various types of electric lamps destined for storage in different warehouses. After cartons leave stitching machine they are placed selectively on one of the five Logan Roller conveyor lines shown. Cartons delivered to proper warehouse by Steel Chutes and Roller Conveyors.

Just as time and work studies, and better utilization of floor space contribute to stepped-up production, so does "flowing" materials handling . . . through expertly engineered Logan Conveyors.

In just about every case, Logan Conveyors are "part of the process" because they are so closely dove-tailed into production procedure. They provide that all-important "steady movement of materials" . . . timed correctly . . . and at proper working heights for operators.

It is quite probable that Logan Conveyors can lower your production costs at one or more plant operations. Why not write for literature?

SINCE Logan 1876

Logan Conveyors

LOGAN CO. INC., 510 CABEL ST., LOUISVILLE, KY.

of the presently required maintenance:

1. Proper materials are still not available. There are few cases in which this is true today; materials may be difficult to obtain, and they may be expensive, but they can be obtained. Also, many new materials and "substitutes" are highly effective. Some are superior to the materials they replace.

2. Top management may feel it essential not to sacrifice production for repairs in those cases where interruptions would result. This is a matter of undertaking a calculated risk. It should not be done without making a thorough investigation of all the factors and possible costs involved.

3. Necessary skilled manpower is not available. While this condition is not limited to plants in small and medium-sized communities, it is far less common in highly industrialized areas.

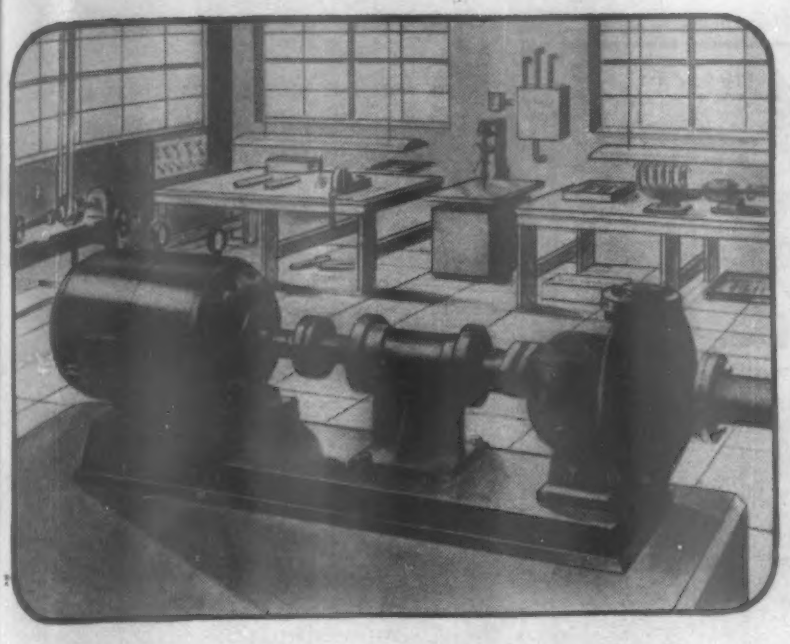
Two things deserve special note in connection with this problem. Skilled manpower *is* available if you are willing to bid high enough to bring it to your plant (from other companies or other areas). The possible industrial and community relations problems arising from such a course, however, are too obvious to require elaboration. If skilled help is unavailable now, it will probably be unavailable next year, barring a substantial economic setback.

In the light of this latter consideration, deferment of maintenance because of the manpower shortage is, at best, a risky business. The alternative is to investigate the possibility of getting the job done by outside contractors. While this may at first appear expensive, especially in remote areas, it is frequently the cheapest—especially in remote areas. If there is a union in the plant, management should not hesitate to take it into full confidence on such a problem. The facilities of an affiliated union can sometimes be most helpful in clearing this particular type of impasse.

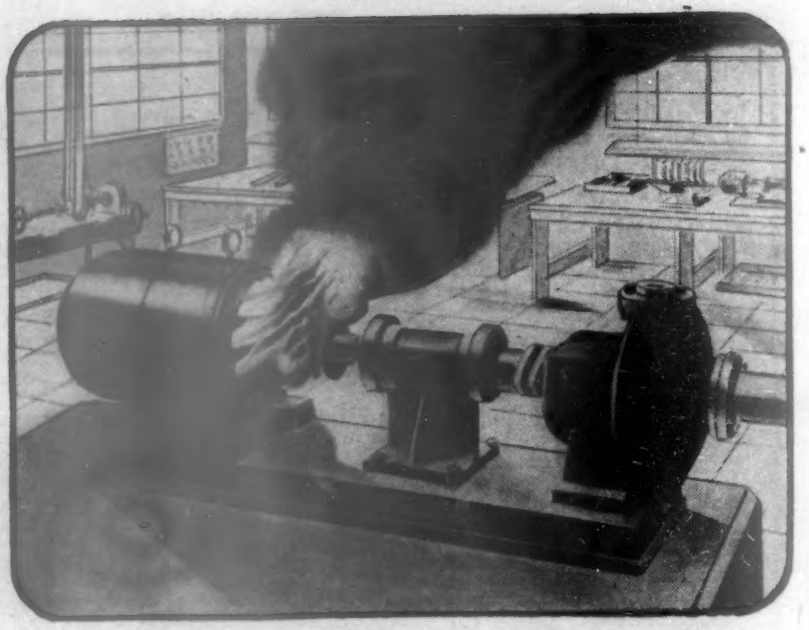
DELAY RATHER THAN DEFER

In any event, the maintenance should not be *deferred,* but rather merely *delayed* until preparations for its execution can be completed. The preparations should be expedited to the greatest possible degree.

In any case, no matter what the reason for deferring maintenance,



Before a small motor—



can touch off a major fire—

CATCH THE FLAMES IN TIME

THE *Kidde* WAY!

Overworked or overloaded motors in your plant—even the smallest—can be a potential fire hazard. Play safe—keep *Kidde** Portable Extinguishers close at hand!

A *Kidde* Portable discharges dry, clean carbon dioxide (CO_2) that can quickly put out electrical fires—without damaging the insulation or corroding metal parts. Since CO_2 is non-conducting, a *Kidde* Portable is safe to use even if circuits are live.

Sizes range from 2½ to 25 pounds CO_2 capacity—a size for every need in portables. All *Kidde* Portables have fast-acting, easy-to-use TRIGGER-FINGER CONTROL. Ask a Kidde representative for full details.

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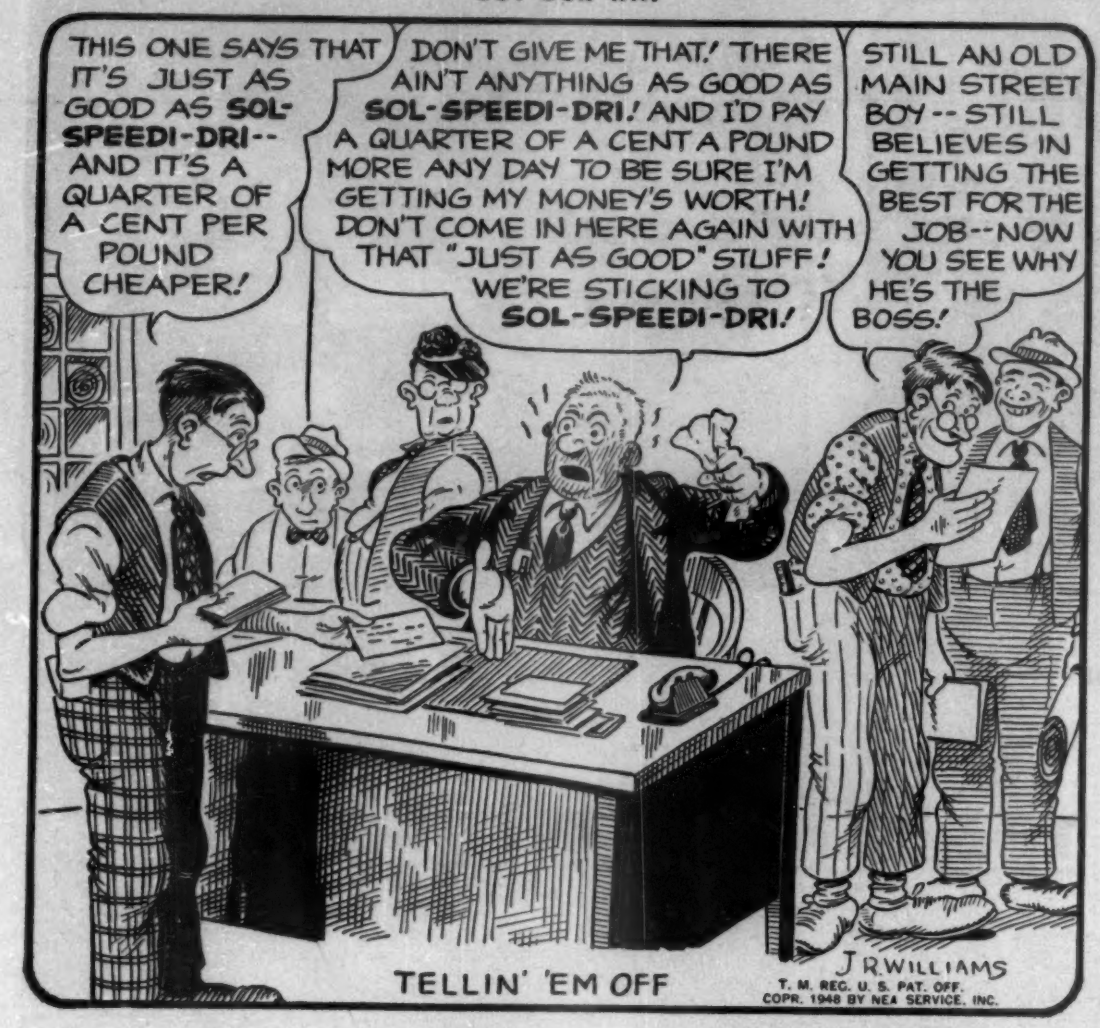
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STILL AN OLD MAIN STREET BOY -- STILL BELIEVES IN GETTING THE BEST FOR THE JOB--NOW YOU SEE WHY HE'S THE BOSS!
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WHEN YOU BUY, BE *SURE* IT'S SOL-SPEEDI-DRI!

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funds for the work should be appropriated now and placed in a cash (as distinguished from "paper") reserve.

THE NEW PLANT

Ideally, maintenance for the new plant should be well under way *before* the architects begin drawing up the first set of blueprints.

Good maintenance can be practiced in any plant. Truly low-cost maintenance must be designed and built into the plant. With the always-available cooperation and assistance of the architects and builders, this objective can be accomplished by these simple steps:

1. As soon as the decision is made to build a new plant, assign a competent maintenance engineer to work with the engineers preparing specifications for the architects. It should be the function of the maintenance engineer to prepare appendixes to the specifications, setting forth in broad terms the basic maintenance requirements of the structure and of the several physical components.

2. The same maintenance engineer holds a series of conferences with the designers as their work progresses. The purpose of these conferences is twofold. First, the engineer amplifies and details his requirements as the architects experience the need for such additional information. Second, the engineer is kept cognizant of the limitations within which maintenance can be designed, and within which he will later have to work. The natural result of such conferences is to give to the maintenance engineer an intimate understanding of the construction details which bear upon his responsibility for keeping the plant running.

3. The maintenance engineer must be on the site periodically while actual construction is in progress. The frequency of such visits depends somewhat on physical accessibility of the site, but to the greatest degree possible is determined by the size and complexity of the project. In a large plant, where a staff of maintenance specialists is contemplated, it is well to have as many as possible view the work as it progresses, paying particular attention to their specialties. A knowledge of blueprints and material specifications is invaluable to maintenance engineers, but supplemented by an intimate, per-

WHY GE *Watch Dog** STARTERS

can reduce your costs and increase lighting efficiency

The starter contributes more than any other single accessory to the useful life of fluorescent lamps. Here's why:

1. **The right starter can prolong the life of both lamp and ballast.**
2. **The right starter can decrease maintenance time and replacement costs.**
3. **The right starter can add to lighting efficiency, thus improving working conditions.**

And the right starter for your installations is the General Electric Watch Dog — the starter that automatically cuts out failing lamps before ballasts and circuits are harmed. The General Electric Watch Dog gets rid of the nuisance of blinking lamps, tells your maintenance men immediately when lamps need replacement. This extra-quality starter lasts long in service, too. In fact, it often lasts many times longer than conventional starters.

Starters are only one part of the complete line of accessories that General Electric makes, to help *you* make the most of fluorescent lighting. Better check with your lighting contractor, or supplier, to make sure that the fixtures you buy and the lighting systems you operate are G-E equipped *all the way through*. For complete information, write to Section D9-434, General Electric Company, Bridgeport 2, Connecticut.

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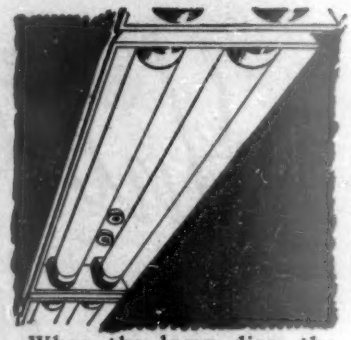
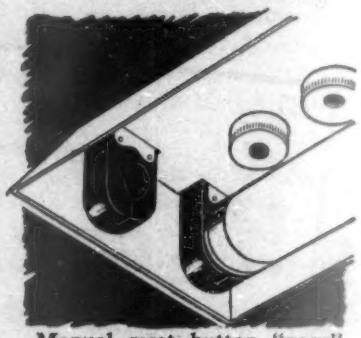
FREE
Fluorescent Lamp Starter Chart helps you pick the right starters for your installations. Write for yours today.

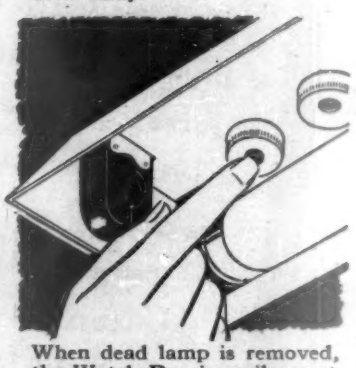
HOW G-E WATCH DOGS WORK



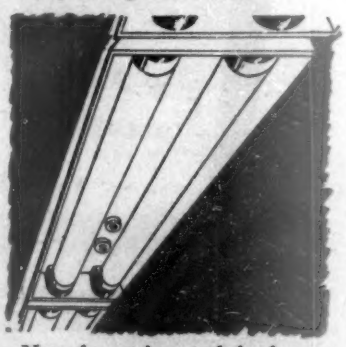
When the lamp dies, the Watch Dog cuts itself out of the circuit, stops blinking.



Manual reset button "pops" up when starter cuts off on dead lamp.



When dead lamp is removed, the Watch Dog is easily reset by pressing the button.



New lamp inserted in lampholder immediately begins to operate normally.

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sonal acquaintance with the physical construction, it is unbeatable.

Maintenance Procedures

If 1948 is used to make all the needed repairs and replacements, both major and minor, maintenance in 1949 and after can be, relatively at least, both simple and inexpensive. If a checklist has not been used for maintenance inspectors in the past, one should be made up during the course of a thorough survey. Even where a checklist has been used, it can be improved and expanded, and brought up to date.

The basic list covers every item subject to wear, neglect, or damage. Where low safety factors, overload conditions, or substandard materials are known to exist, the basic list is supplemented by an exhaustive inventory of such potential trouble spots, as described above.

There are two important elements sometimes missing from maintenance inspectors' checklists:

1. *When shall the next inspection be made?* It is less than useless to compile an extensive checklist if no further inspections are going to be made until the next complete survey—or until trouble forces an inspection. Consequently, each item on the list must be scheduled now for its next inspection; so far as possible, regular inspections should be scheduled for the next ten years.

However, space must be provided on the checklist for noting the need for special inspections after repairs, or for precautionary interim inspections of incipient trouble spots. Perhaps the next regular inspection for a class of items is three years hence; some items may not be in need of immediate repair or replacement, yet may be in a sufficiently advanced stage of deterioration to justify more frequent inspection. Some simple type of tickler system will insure that such special cases are not overlooked.

2. *When shall the next replacement be made?* Some items are replaced on a definite schedule; this schedule should be incorporated into the checklist. Provision must be made for noting (and executing) replacements which will be required out of regular schedule.

One final point is worth noting in connection with checklists. For a real *check*, provide space on the list in which to record the nature of the defects uncovered and action taken. (If remedial action is not within the immediate province of the mainte-

nance department, the inspector or engineer records "proposed action," and later records the disposition of the proposal.)

Initial preparation of maintenance checklists is not inexpensive. But the long-run savings can be tremendous *if the lists are used.*

WHAT TO CHECK

Basic elements for inclusion in any adequate checklist are outlined below. In each case, two fundamental questions must be asked:

1. Does this item require repair (or replacement) to restore it to its original condition and prevent further trouble?

2. Does this item require improvement (beyond its original condition) to prevent further trouble?

Items to check and conditions to look for:

Steel members. Overloading, corrosion, welds, rivets.

Wood members. Overloading, cracks, checks, rotting of sills and at foot of columns.

Concrete members. Overloading, cracks, spalling of girders and columns.

Walls. Cracks, leakage, need for repainting, waterproofing.

Foundation walls and piers. Cracks settling, leakage, waterproofing, drainage.

Floors. Cracks, sagging, warping, drainage, excessive roughness or slipperiness, suitability for service conditions, super-surfaces (steel mats, etc.).

Coping. Loose or missing tile or stone, need for repainting, waterproofing.

Windows. Corrosion, dry rot, leakage, putty, calking, stops, rails, stiles, fasteners, broken panes, re-glazing, need for screening.

Doors. Proper fitting, corrosion, dry rot, leakage, hinges, locks, checks, weatherstripping, calking. On fire-doors, look also for condition of metal covering, fusible links, suspension, operating mechanisms.

Sills and lintels. Cracks, leakage, need for repainting, waterproofing.

Stairways. Lighting, hand rails, anchorage, excessive wear, slipperiness, or other defects of treads and landings. On fire escapes, look also for weakening by corrosion, proper functioning of lift sections, accessibility, obstructions.

Elevator shafts. Corrosion, condi-

prevent this

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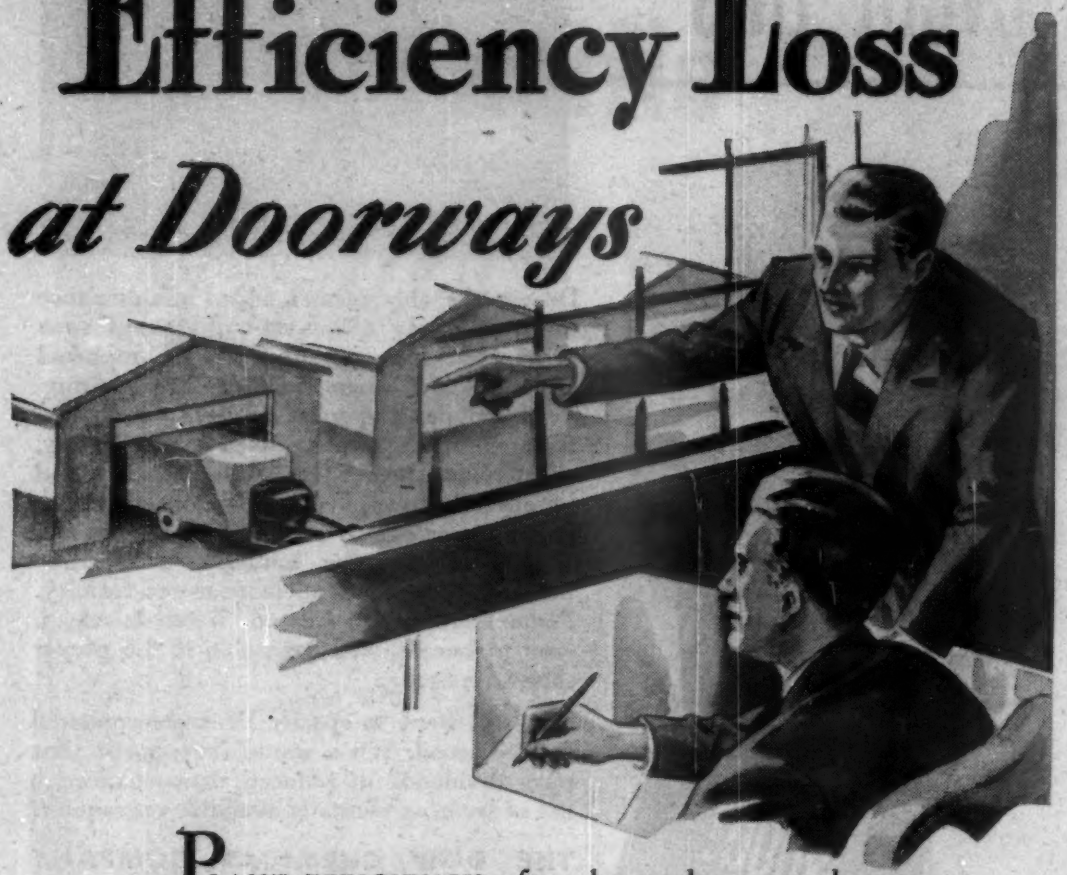
STOP Efficiency Loss *at Doorways*



PLANT EFFICIENCY often bogs down at doorways without letting you know it. Costs pile up while vehicles wait for doors to be opened. Time and labor is lost when busy employees open or close doors. Heating and air-conditioning costs soar when doors aren't closed promptly.

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tion of safety mechanisms, cables, walls, pit, and drain.

Ceilings. Cracks, sagging, leakage.

Roofs. Support, anchorage, cracks, separation of seams, rotting, bubbles, nail holes, water pockets, drying out of paper covering, loose railings.

Flashings. Defective furring strips, loose counter flashing, pinholes, corrosion, defects in flashing felt.

Skylights and monitors. Corrosion, rotting, leakage (especially around base), putty, calking, condition of operating mechanism.

Stacks. Corrosion (inside and out) of metal, cracking or pointing of masonry, supports, guys, braces.

Ventilators and cyclones. Corrosion, leakage, supports, guys, braces, operation of dampers and controls.

Water tanks. Leakage, calking, corrosion and rotting (inside and out), risers, housing, supports, ladder, walk, rails, airplane warning lights, heating system, accessories.

Signs. Corrosion, supports, braces, legibility.

Gutters and downspouts. Anchorage, restraining straps, obstructions.

Canopies. Anchorage, supports, corrosion, rotting, drainage.

Platforms. Cracking, chipping, splinters, loose angle-iron curbing, condition of railings, steps, supporting structure and floor (see above).

Outdoor walks. Cracking, settling, heaving, drainage, condition of steps and railings.

Fences. Anchorage, posts, braces, gates, mesh, or other fencing material.

Hydrants. Rusting, condition of valves, threads, obstruction.

Trestles or bridges. Corrosion, rotting, cracks, sagging, settling, supports, foundation.

Overhead pipelines, ducts, conduits. Corrosion, supporting structure, hangers on supports, anchor bolts, coverings, and insulation.

Overhead cranes, conveyors. Corrosion, supporting structure, anchor bolts.

Sewers. Leakage, covers, manholes, obstructions.

Platform scales. Corrosion of steel work, condition of walls, floor of pit.

Railroad tracks. Loose spikes, rail joints, condition of switches, ballast.

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for using Square D Control

New "OFF-THE-SHELF" Parts Kits make normal maintenance easier than ever!

All motor starters and contactors are subject to periodic contact replacement under conditions of heavy load or frequent operation. That's why Square D has always stressed accessibility of these parts. Now, the parts themselves are packaged in easy-to-stock kits to make that replacement job even more simple.

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